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Design and Operation of an Information Center on Analytical Methodology

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27 Abstract
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The contractual requirements were met during a nine-month research period by th following activities: definition and statement of the AQCL scope of interests; acquisiti of a total of 1145 technical reports and articles; abstracting and indexing of 470 techni documents; preparation of three prototype issues of a current awareness bulletin entitled "Reviews of Current Literature on Analytical Methodology"; preparation of 115 items for i put to the Water Resources Scientific Information Center; provision of 13 quick responses to technical inquiries as well as other information services such as document loans and translations; consideration of methods for interacting with other facilities such as the Science Information Exchange (SIE); development of a procedure for processing and inputti information to a computerized information storage and retrieval system; demonstration of computerized information storage and retrieval system at AQCL; Recommendations for an operational information center on analytical methodology; cost analysis of the recommended information center.

Complete discussions of all these activities are included in the report (Little-Battelle)

Abstractor Robert L. Little	Institution Battelle Memorial Institute, Columbus Laboratories, Ohio

WR:102 (REV JULY 1969)
WRSIC

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U.S. DEPARTMENT OF THE INTERIOR
WASHINGTON, D.C. 20240

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DESIGN AND OPERATION OF AN
INFORMATION CENTER ON ANALYTICAL METHODOLOGY

by

Battelle Memorial Institute

505 King Avenue
Columbus, Ohio 43201

for the

ENVIRONMENTAL PROTECTION AGENCY

Program #16020FSOG/71
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June, 1971

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ABSTRACT

Under WQO Contract Number 14-12-862, the Columbus Laboratories of Battelle Memorial Institute were commissioned to "design and operate a pilot analytical methodology information storage and retrieval system tailored to the needs of the Analytical Quality Control Laboratory (AQCL) and other segments of the National Analytical Methods Development Research Program (NAMDRP)".

The contractual requirements were met during a nine-month research period by the following accomplishments:

1. Definition and statement of the AQCL scope of interests.
2. Acquisition of 1145 technical reports and articles.
3. Abstracting and indexing of 470 technical documents.
4. Preparation and evaluation of three prototype issues of a current awareness bulletin entitled "Reviews of Current Literature on Analytical Methodology".
5. Preparation of 115 technical abstracts for input to the Water Resources Scientific Information Center.
6. Preparation of 13 quick responses to technical inquiries.
7. Provision of document loans and limited translation services.
8. Consideration of methods for interacting with other facilities such as the Science Information Exchange (SIE).
9. Development of a procedure for processing and inputting information to a computerized information storage and retrieval system.
10. Demonstration of a computerized information storage and retrieval system at AQCL.
11. Recommendations for an operational information center on analytical methodology.
12. Cost analysis of the recommended information center.

Complete discussions of all these activities are included in the report.

This report was submitted in fulfillment of Project Number 16020FSO, Contract 14-12-862, under the sponsorship of the Water Quality Office, Environmental Protection Agency.

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SECTION I

RECOMMENDATIONS FOR A FULL-SCALE OPERATION OF AN ANALYTICAL METHODOLOGY INFORMATION CENTER

General Recommendations

During the nine-month research period, virtually all aspects of information center operation were explored by the pilot information center designated the Analytical Methodology Information Center (AMIC). Particular attention was focused upon determining the parameters of an operational center which would meet the needs of the Analytical Quality Control Laboratory (AQCL) and other segments of the National Analytical Methods Development Research Program (NAMDRP).

The feasibility of an analytical methodology information storage and retrieval system was demonstrated in detail by the pilot center. In addition, the demand for services and the reception of the user audience to these services demonstrated a great need for information services not only at AQCL but also within the Division of Water Quality Research (WQR) and at the various regional laboratories. All WQR personnel who came in contact with the activities of the pilot center expressed a need for information services and were enthusiastic about the potential of AMIC for satisfying these needs. Therefore, the basic recommendation of this report is that an operational Analytical Methodology Information Center be implemented as soon as possible. Whether such a center is established within a laboratory of the Office for Research and Monitoring or is operated by an outside contractor will be dependent upon the availability of properly trained staff and adequate facilities, and the discretion of the sponsoring organization.

Recommendations for establishing an operational center are presented in the following sections.

Information Center

Organization, Staffing, Operation, and Information System

A. Since the AQCL is officially assigned the responsibility of establishing standard analytical methods for the Office for Research and Monitoring, the Analytical Methodology Information Center should serve as an arm of that laboratory.

B. The center should continue to base its acquisitions on the scope statement developed during the pilot study, but should modify that scope as the interests and needs of the user audience change.

C. The staff of the center should consist of a minimum of:

1 project leader/information scientist
1 information scientist
2-1/4 secretarial/clerical support
part-time Washington liaison
part-time administrator.

Additional part-time staff will be needed for a total of about 3/4 time to provide technical and services support to the information center.

D. Coverage of the literature should be maintained by reviewing the journals and abstract sources listed in Appendices D and E. Subscriptions should be placed for those journals which frequently contain items of high interest. These journals are listed in Appendix H. Acquisition of Government research reports should be given high priority. The center's staff should also be alert to potential new sources of information, especially foreign and state and municipal governments. A concerted effort also should be made to keep the center informed of the activities and reports available at other EPA Laboratories.

E. The rate of document processing is anticipated to be about 1850 new items per year. During the pilot project, a backlog of about 675 additional items was accumulated which should be processed during the first year of full-scale operation. This would result in a total of approximately 2400 items for processing during the first year of full-scale operation.

F. As the need arises within AQCL, full use should be made of other, related resources in acquiring knowledge of on-going research which may not yet be published within the public domain. This would include not only SIE but also could include direct contact with research laboratories identified in the literature as carrying on related research activities.

G. Because of the uniqueness of interests of the analytical methods community, the information storage and retrieval system should be a computerized interactive system and initially be established as an autonomous unit. This does not preclude eventual merging with an EPA centralized or network information system if that mode of operation is deemed feasible at some future time.

H. The cognizant laboratory as well as the information center should be equipped with remote terminals for querying the system. The amount of usage by the center itself, AQCL, and the regional laboratories (on an experimental basis) is expected to be 2 hours per day, 50 weeks per year. Whether the terminals are cathode ray tubes or teletype units will depend upon the needs as recognized by the Project Officer. One or two additional terminals should be available to provide WQR Headquarters and other WQR Laboratories access to the information base on a trial basis. As part of this activity, the possibility of providing the regional laboratories access to the information base on a cost-incurred basis should be considered.

I. Funds should be allocated for vocabulary control as described within this report.

J. Processing methods similar to those based in the pilot study should be employed to minimize retyping costs and expedite preparation of machine-readable input. Further, in conjunction with this recommendation, the possibility of supplying this machine-readable input to WRSIC or other information systems should be investigated.

Services

The information services to be performed by the operational center should include, in addition to the acquisitions and processing efforts, the provision of:

1. A Monthly Current Awareness Bulletin Containing Indexed Abstracts of Literature on Analytical Methods. The items included should be printed in 3" x 5" format on card stock. The feasibility of perforating the individual items and of distributing selected portions of the bulletin according to technical interests should be investigated.

   The bulletin should be distributed to those persons who received the prototype issues. Modifications in the circulation list will be at the discretion of the Project Officer.

2. Loan Services Primarily to the Staff of the Cognizant Laboratory. The possibility of arranging with the EPA Library at the Taft Research Center to provide portions of the loan services should be investigated.

3. Limited Translation Services. Because of the high cost, translations of selected foreign-language documents would be made only with the approval of the Project Officer.

4. Purchase of Selective Dissemination of Information (SDI) Services. This service would be purchased by the information center and distributed to the proper personnel within the cognizant laboratory. The technical personnel, in turn, would identify useful material for inclusion in the information center.

5. Quick Response Inquiries (QRI's). Funds should be provided for approximately 20 QRI's to AQCL and 45 to the Division of Water Quality Research Headquarters annually. All requests for this service would be channeled through the Project Officer.

6. Preparation of Abstracts as Input to WRSIC. The center should, on a regular basis, contribute abstracts of those documents concerned with analytical methods to the Water Resources Scientific Information Center (WRSIC) or other centralized information unit specified by the Environmental Protection Agency.

7. Investigation of the Feasibility of Conducting Technical Analysis Tasks. This type of activity could, if required, be implemented during the first year of full-scale operation if add-on funds were to be allocated.

Travel

Funds should be allocated to allow frequent (perhaps biweekly) contact with the staff of the cognizant laboratory. In addition, at least one visit should be made to some other WQR Laboratory, possibly the Southeast Water Laboratory, and provision should be made for limited contact with other facilities in Washington, D.C. Funds should also be available to permit liaison with WQR Headquarters in washington, D.C., since those contacts serve to keep the staff of the center aware of the areas of concern to the national program.

Final Report

A final report should be prepared at the end of the operational year of the full-scale information center to summarize the results and procedural modifications and suggest means of improving the center's effectiveness.

SECTION II

PURPOSE OF CONTRACT

During 1969, the Battelle Memorial Institute provided in-house funds to study the structure, operation, problems, laboratory interactions, and communication-information needs, and other facets of the (then) Federal Water Pollution Control Administration.(Reference 1) Certain information needs within FWPCA became apparent as a result of this study. One of the needs identified existed within the Analytical Quality Control Laboratory. Based upon this recognition, Battelle's Columbus Laboratories proposed to provide assistance in finding solutions to the information needs of AQCL. The present program to provide technical assistance in the development and operation of the Center of Competence in Analytical Methodology was subsequently established.

Under this program, Battelle was commissioned to design and operate a prototype information center, which for the purposes of this report has been designated the *"Analytical Methodology Information Center"* or *"AMIC"*, to serve as a model for full-scale operation. The establishment of the Analytical Methodology Information Center was to include defining the technical scope of operation, developing an acquisitions program, investigating ways of interfacing with other documentation and information facilities already operating within the Environmental Protection Agency, establishing methods and procedures for document processing, and recommending storage and retrieval mechanisms. These recommendations were to be effected by actually processing information into an information system and providing assistance to AQCL and the Division of Water Quality Research in the form of quick response inquiries, current-awareness services, report loan and copy service, and other adjunctive services. The ultimate purpose of the contract, therefore, was to provide guidelines for establishing a full-scale information system which will satisfy AQCL's requirements based upon the experiences gained from operating the prototype center.

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SECTION III

INTRODUCTION

Preliminary to designing an information system to meet the needs of the Analytical Quality Control Laboratory (AQCL), it is useful to examine the organizational responsibilities as well as the activities of that Laboratory.

AQCL Organization

When the AMIC contract went into effect, the AQCL was part of the Federal Water Quality Administration. During the contract period, however, a new federal agency, the Environmental Protection Agency (EPA), was created to combine and administer all federal programs concerned with the quality of the environment. As a consequence of this action, the FWQA became part of the EPA and the program elements were assigned to the various Assistant Administrators. (Figures 1, 2, and 3.)

The AQCL itself, as shown in Figure 4, is organized along technical lines so that maximum capabilities are concentrated in areas of greatest need. As discussed in the section on Scoping and Definition, this organizational arrangement provided the basis for defining the scope of the prototype information center.

AQCL Responsibilities

In essence, AQCL has three assignments to satisfy by its activities: (1) provide technical assistance to the regional and national water programs (2) conduct the National Analytical Methods Development Research Program (NAMDRP) and (3) serve as a center of competence for the Water Resources Scientific Information Center (WRSIC).

Federal Water Program

It is quite obvious that AQCL, as an arm of EPA's Office of Research and Monitoring, and more specifically of the Division of Water Quality Research, must support the federal water program which includes acquisition of water quality data, determination of compliance with water quality standards, dissemination of information for planning water resources development, evaluation of the effectiveness of water pollution abatement procedures, and related research. AQCL supports the federal program by conducting programs which will ensure the reliability and legal defensibility of physical, chemical, and biological data which are collected by various laboratories throughout the U. S. These programs include research on analytical methods, providing leadership in the selection of field and laboratory

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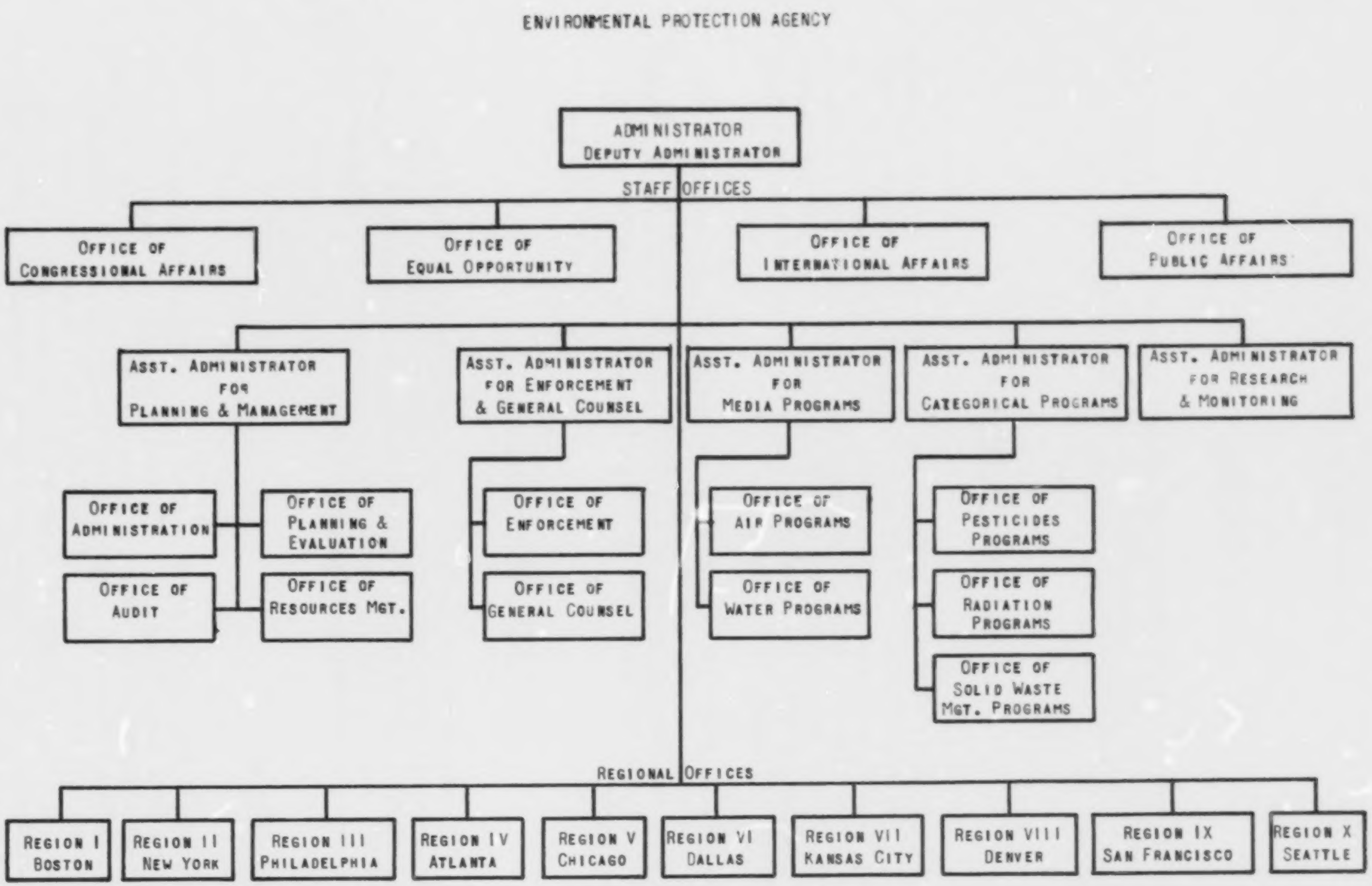

ENVIRONMENTAL PROTECTION AGENCY
ADMINISTRATOR
DEPUTY ADMINISTRATOR
STAFF OFFICES
OFFICE OF CONGRESSIONAL AFFAIRS
OFFICE OF EQUAL OPPORTUNITY
OFFICE OF INTERNATIONAL AFFAIRS
OFFICE OF PUBLIC AFFAIRS
ASST. ADMINISTRATOR FOR PLANNING & MANAGEMENT
ASST. ADMINISTRATOR FOR ENFORCEMENT & GENERAL COUNSEL
ASST. ADMINISTRATOR FOR MEDIA PROGRAMS
ASST. ADMINISTRATOR FOR CATEGORICAL PROGRAMS
ASST. ADMINISTRATOR FOR RESEARCH & MONITORING
OFFICE OF ADMINISTRATION
OFFICE OF PLANNING & EVALUATION
OFFICE OF AUDIT
OFFICE OF RESOURCES MGT.
OFFICE OF ENFORCEMENT
OFFICE OF GENERAL COUNSEL
OFFICE OF AIR PROGRAMS
OFFICE OF WATER PROGRAMS
OFFICE OF PESTICIDES PROGRAMS
OFFICE OF RADIATION PROGRAMS
OFFICE OF SOLID WASTE MGT. PROGRAMS
REGIONAL OFFICES
REGION I BOSTON
REGION II NEW YORK
REGION III PHILADELPHIA
REGION IV ATLANTA
REGION V CHICAGO
REGION VI DALLAS
REGION VII KANSAS CITY
REGION VIII DENVER
REGION IX SAN FRANCISCO
REGION X SEATTLE

FIGURE 1. ORGANIZATION OF THE ENVIRONMENTAL PROTECTION AGENCY (Reference 2)

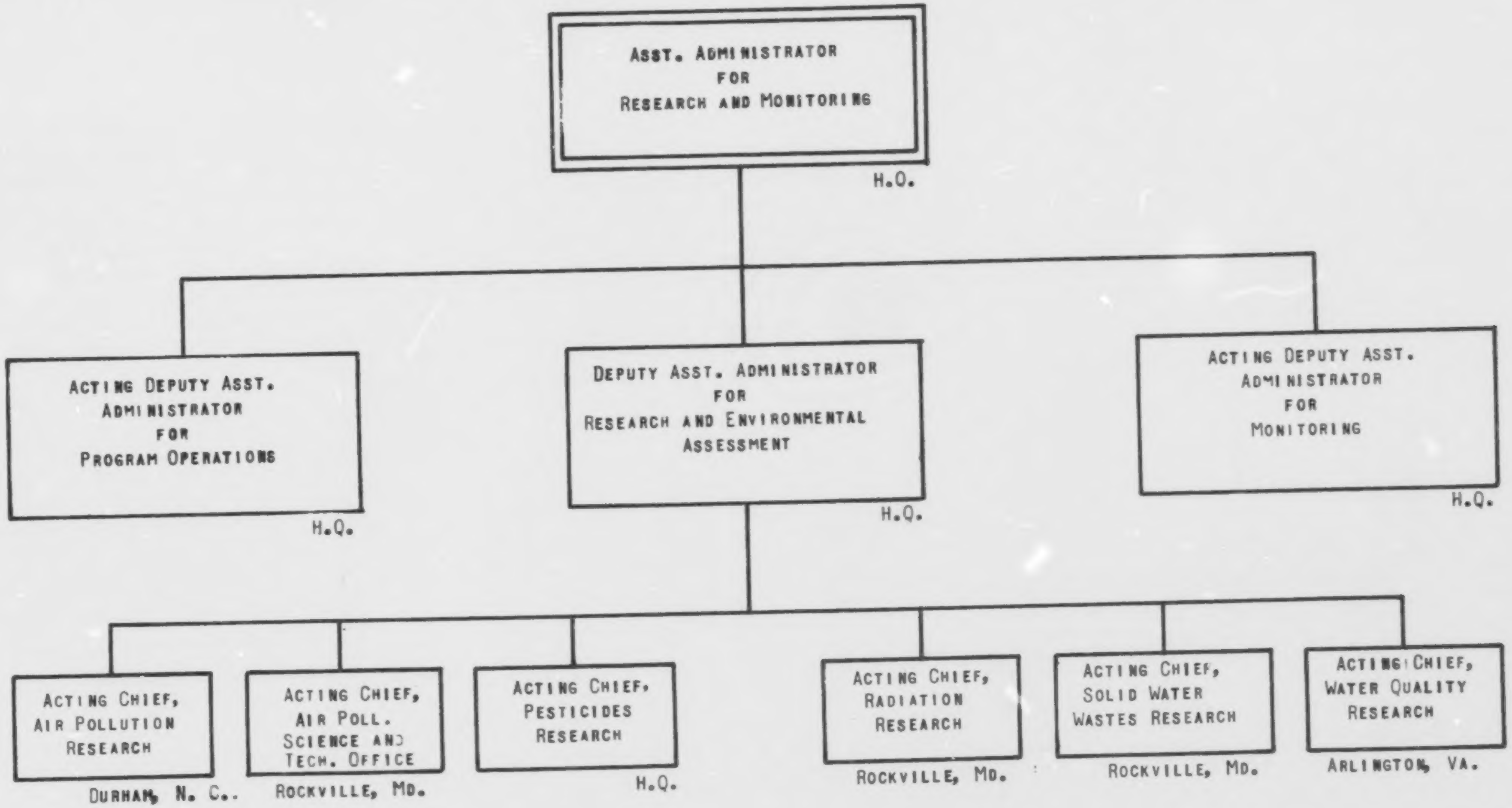
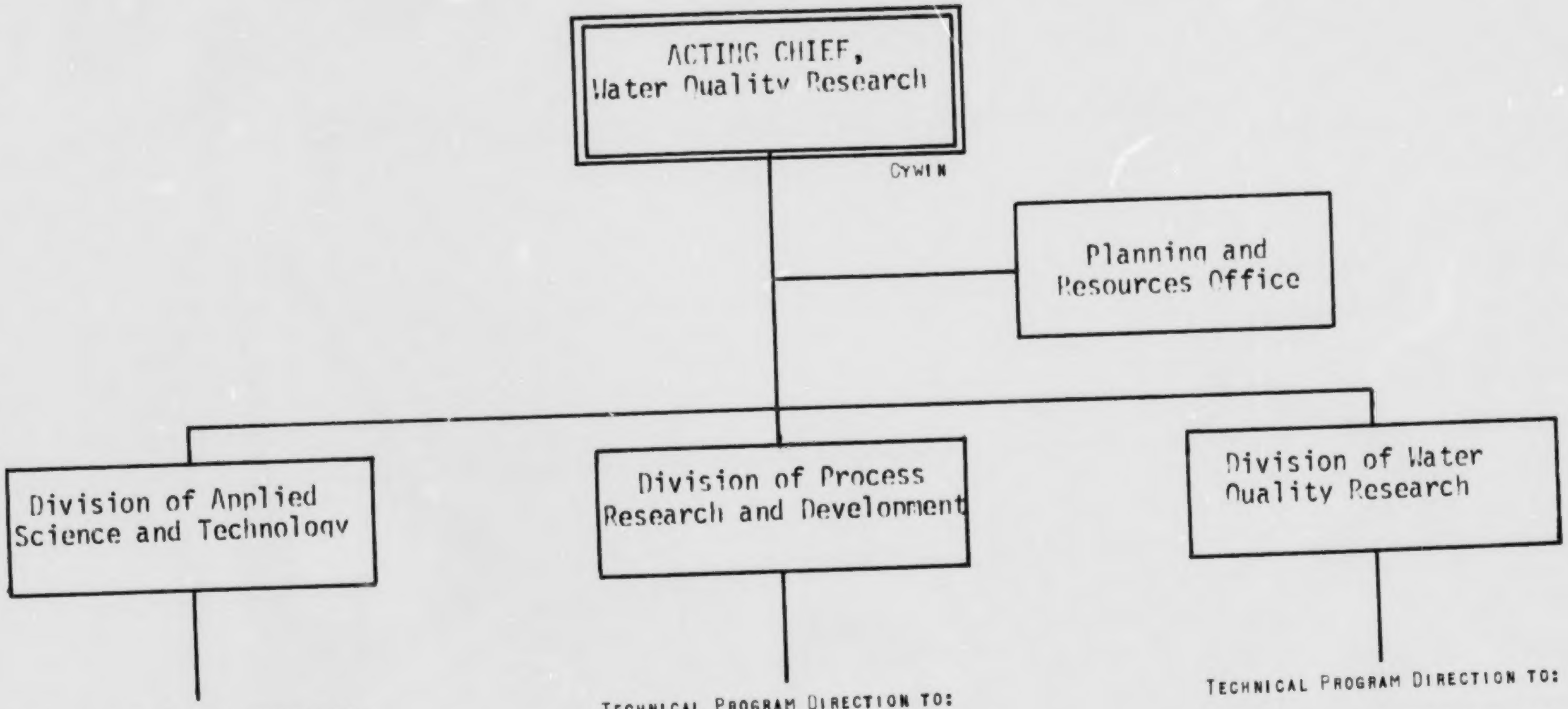

ASST. ADMINISTRATOR FOR RESEARCH AND MONITORING
H.Q.
ACTING DEPUTY ASST. ADMINISTRATOR FOR PROGRAM OPERATIONS
H.Q.
DEPUTY ASST. ADMINISTRATOR FOR RESEARCH AND ENVIRONMENTAL ASSESSMENT
H.Q.
ACTING DEPUTY ASST. ADMINISTRATOR FOR MONITORING
H.Q.
ACTING CHIEF, AIR POLLUTION RESEARCH
DURHAM, N. C..
ACTING CHIEF, AIR POLL. SCIENCE AND TECH. OFFICE
ROCKVILLE, MD.
ACTING CHIEF, PESTICIDES RESEARCH
H.Q.
ACTING CHIEF, RADIATION RESEARCH
ROCKVILLE, MD.
ACTING CHIEF, SOLID WATER WASTES RESEARCH
ROCKVILLE, MD.
ACTING CHIEF, WATER QUALITY RESEARCH
ARLINGTON, VA.

FIGURE 2. ORGANIZATION OF THE OFFICE FOR RESEARCH AND MONITORING (Reference 2)


ACTING CHIEF,
Water Quality Research
CYWIN
Planning and
Resources Office
Division of Applied
Science and Technology
Division of Process
Research and Development
Division of Water
Quality Research

TECHNICAL PROGRAM DIRECTION TO:

IND. & AGR. POLL. CONTR. RES. PROGRAM,
SOUTHEAST WATER LAB., ATHENS GEORGIA
MINE DRAINAGE POLL. CONTR. RES. ACTIVITIES
R.A. TAFT WATER RES. CTR., CINTI., OHIO
RESEARCH & DEVELOPMENT BRANCH,
HUDSON-DELAWARE BASINS OFF., EDISON, N. J.
TREATMENT & CONTROL RESEARCH PROGRAM,
R. S. KERR WATER RES. CTR., ADA, OKLA.
WASTE TREATMENT RESEARCH PROGRAM
PACIFIC N.W. WATER LAB., CORVALLIS, ORE.

TECHNICAL PROGRAM DIRECTION TO:

ADVANCED WASTE TREATMENT RES. LAB.
R. A. TAFT WATER RES. CTR., CINN., OHIO
ALASKA VILLAGE DEMONSTRATION PROGRAM AND
COLD CLIMATE RESEARCH PROGRAM
ALASKA WATER LAB., COLLEGE, ALASKA
WATER QUALITY CONTROL RESEARCH PROTRAM
R. S. KERR WATER RES. CTR., ADA, OKLA.

TECHNICAL PROGRAM DIRECTION TO:

ANALYTICAL QUALITY CONTROL LAB.,
CINTI., OHIO
GROUND WATER POLL. RESEARCH PROGRAM,
R. S. KERR WATER RES. CTR., ADA, OKLA.
NAT'L COASTAL POLL. RESEARCH PROGRAM
NAT'L EUTROPHICATION RES. PROGRAM AND
NAT'L THERMAL POLL. RESEARCH PROGRAM
PACIFIC N.W. WATER LAB., CORVALLIS, ORE
NAT'L MARINE WATER QUALITY LAB.,
WEST KINGSTON, RH. ISLAND
NAT'L WATER QUALITY LABORATORY
DULUTH, MINN.
POLLUTION FATE RESEARCH PROGRAM AND
WATER CONTAMINANTS CHARACTERIZATION
RESEARCH PROGRAM

(Reference 3)

FIGURE 3. ORGANIZATION OF WATER QUALITY RESEARCH

ANALYTICAL QUALITY CONTROL LABORATORY

D. G. Ballinger, Director

PHYSICAL AND CHEMICAL METHODS ACTIVITY	BIOLOGICAL METHODS ACTIVITY	MICROBIOLOGICAL METHODS ACTIVITY	INSTRUMENTATION DEVELOPMENT ACTIVITY	METHODS AND PERFORMANCE EVALUATION ACTIVITIES
R. Kroner	C. Weber	R. Bordner	A. Mentink	J. Winters
General Analysis Group Spectroscopy Group Organics Group	Benthos Group Plankton-Pheriphyton Group			

FIGURE 4. ORGANIZATIONAL STRUCTURE OF THE ANALYTICAL QUALITY CONTROL LABORATORY

procedures, conducting a reference sample program for methods verification and laboratory performance, advising laboratories in the development of internal quality control, developing and evaluating automatic water quality monitoring instrumentation, and assisting the EPA Regions in the procurement and installation of this type of equipment.(Reference 4) Further detail on AQCL's technical activities is included in Appendix A.

National Analytical Methods Research Program

Early in 1970, the assistant commissioner for Research and Development and the assistant commissioner for Operations initiated the National Analytical Methods Development Research Program (NAMDRP) by issuance of a joint memorandum, which was amended July 7, 1970. (See Appendix B for complete memoranda.) This program was established to assist the Division of Water Quality Research in fulfilling its responsibility of developing analytical methods for the Federal Water Quality Administration (FWQA).

Three categories of methodology were recognized in this program: (a) Research, (b) Standard, and (c) Special. Prime responsibility for Standard Analytical Methodology was assigned to the Analytical Quality Control Laboratory (AQCL) at Cincinnati, Ohio.

AQCL's responsibilities as specified by NAMDRP are to:

1. Develop "tools of the trade",
2. Ensure the reliability of analytical data gathered anywhere within EPA,
3. Determine deficiencies in present analytical methods where they are applied to salt water samples.

Under this authorization, AQCL retains responsibility for standard analytical methodology and is assigned additional responsibility for marine waters. Also under this authorization, only AQCL may issue official EPA publications on analytical methods. Other laboratories may publish accounts of their analytical research, but may not indicate that they constitute official EPA methods.(Reference 5, 6)

Water Resources Scientific Information Center Assignment

An additional responsibility was assigned to AQCL when it was designated by the Water Resources Scientific Information Center as the center of competence for "Methods for Chemical and Biological Identification and Measurement of Pollutants".(Reference 7)

In its role as the center of competence in analytical methodology, the Analytical Quality Control Laboratory has a dual information responsibility. First, its own scientific staff must remain abreast of the wealth of new information related to analytical methods for determining water quality and other pertinent scientific information which provide the background for developing new methodology and determining its effectiveness. Second, AQCL is assigned the responsibility for selectively providing information relating to its subject areas to the Water Resources Scientific Information Center (WRSIC). This input is to be provided in the form of abstracts and index terms formatted according to WRSIC guidelines.

Knowledge of the organization, activities, and responsibilities of AQCL, as discussed in the previous paragraphs, served as a broad outline for beginning the operation of a prototype information center.

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SECTION IV

METHODS OF SCOPING AND DEFINITION

Possibly the most fundamental element in the design of an information center is the formulation and definition of the scope of activities. It is this step in the design that defines the "world" in which the center will operate, and it is upon this definition that subsequent activities, such as acquisitions, are based. It is important to note that the scope of a center should not necessarily remain fixed, but may in fact be very fluid, gradually encompassing new technical areas of interest while, at the same time, eliminating other areas. Much of the fluidity of the scope results from variations of interest within the technical community served by the center. For any information center to be a viable adjunct to the technical community, it must continually be alert and responsive to the variations of the scope of interest of the user audience

With the introduction of new technology and new products, it is reasonable to expect that new problems in maintaining water quality will arise which will overshadow or supersede former areas of interest and consequently necessitate emphasis on new areas of activity. However, it must likewise be recognized that, within the initial scope description, there are basic elements which will remain largely unchanged.

Methods for Determining Scope

Since the Analytical Methodology Information Center program was established to assist directly the Analytical Quality Control Laboratory of the Division of Water Quality Research (Cincinnati), scoping and definition were based primarily upon the interests within that facility as determined from four main activities: (1) personal interviews with technical and management staff, (2) Review of AQCL's work plans as of June 1970, (3) preparation of the current awareness bulletin, and (4) quick responses. The latter two activities are described in detail in later sections of this report. However, discussion of their relation to the scoping efforts are more appropriately included here along with the discussion of the personal interviews and the AQCL work plans.

Personal Interviews

Because of the importance of proper scoping and definition to the prototype center, considerable effort was devoted to this phase of the investigation. Using unstructured interview techniques, a direct, personal approach was used in order to assure the interest and response of individual AQCL staff members. Their response and cooperation were most rewarding.

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The initial interviews, conducted in July 1970, were designed to permit the AQCL staff members the utmost latitude in describing their individual areas of responsibility and professional interests. The basis for these interviews was a semi-formal presentation of the objectives of the program, the anticipated method of operation, and the expected results. This original presentation was immediately followed by personal interviews. Subsequent discussions of scientific and technical areas related to, but beyond analytical methodology, per se, were encouraged. As a result of the initial interviews, several of the AQCL staff later prepared and submitted lists of terms representing their interests. In addition, a list of the journals circulated within AQCL provided excellent guidance to the information sources of prime interest to staff members. Following these initial interviews, efforts were made to identify and acquire technical articles and reports of interest to the AQCL staff.

In September 1970, a second series of interviews was conducted with individual AQCL staff members utilizing a more structured approach. Based upon the first interviews, some 85 articles were selected from the open literature and segregated in accordance with individual interests. Each staff member contacted during the second meeting was asked to review the material and to comment upon its apparent value to him. Based upon the direct comments obtained during these sessions, the preliminary scope of interests was further defined.

A third visit employing the individual interview technique, was made in November 1970. Emphasis, however, was shifted from the journal literature to Federally supported report literature. The responses during these interviews again resulted in refinement in the scope of interests of the various segments of AQCL.

As previously stated, it was expected that the scope of AQCL's interests would be fluid. While the interview phase of the scoping study was completed, refinement of scope continued in the form of feedback from the publication of the current awareness bulletin, "Reviews of Current Literature on Analytical Methodology", further personal contact, and requests for quick response services.

AQCL Work Plans for FY 1971

The aims and future activities of AQCL as a whole are based upon the projections by the staff of technical areas of critical importance. These projections, obviously, are based upon experience, current activities, and current and anticipated needs. The final result of this planning - the formulation of future work plans - very explicitly reflects the technical areas of critical importance for the present and immediate future and therefore serves as valuable guidance for scoping and definition. The AQCL work plans as of June 1970 are included in Appendix C. These plans provide an excellent overview of the activities within AQCL.

Current Awareness Bulletin

Several aspects of the preparation and publication of the current awareness bulletin ("Reviews of Current Literature on Analytical Methodology") proved to be of great benefit in scoping and definition.

After the draft of the first bulletin was prepared, it was sent to the Project Officer for his comments. He further circulated it to the chiefs of the Activities of AQCL for their comments and suggestions. The result of their review was a well summarized statement of the scope of each Activity. These statements are included on the sample current awareness bulletins reproduced as Figures 12a and 12b in a later section of this report.

In addition, an evaluation form was included with each copy of the current awareness bulletin distributed to the AQCL staff. This form permitted each technical staff member to indicate his degree of interest in each report included in his general area of interest. By reviewing the individual and the summarized forms, the Battelle investigators were able to determine what types of information were of most importance, lesser importance, or of no interest to the staff. Furthermore, the evaluation forms contained space for comments. On several occasions, the staff took advantage of this space to indicate areas of special interest which warranted further coverage. In these ways, the current awareness bulletin contributed significantly to the scoping effort in addition to serving the intended purpose of informing the staff of the recently acquired items in the Analytical Methodology Information Center. (The "Reviews" are discussed in greater detail beginning with page 56.)

Quick Response Inquiries

Quick-response activities (see page 54 for definition) can serve two beneficial purposes in scoping and definition. First, quick-response inquiries during the initial phases of operation provided further guidelines to the scope of interests. Second, and more important in the long term, they enable the center to maintain the fluidity of scope which is required to assure the viability of a center.

Quick-response inquiries made only a limited contribution to the scoping effort because (1) only a relatively small amount of money was available for this type of service, (2) a few of the inquiries were obviously of emphemeral interest, and (3) the prototype center did not operate long enough to detect any modifications of the scope. It is apparent that in the operation of a full-scale center, quick-response activities will play a much more important part in identifying the current scope of interest.

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SECTION V

SCOPE OF THE PROPOSED INFORMATION CENTER

The Analytical Quality Control Laboratory is comprised of five Activities: Physical and Chemical Methods, Biological Methods, Microbiological Methods, Methods and Performance Evaluation, and Instrument Development.

Because of the importance of the scope of coverage to the success or failure of an information center, the following paragraphs present in considerable detail the results of Battelle's study of the scope of information required by AQCL.

Topics of general interest to the staff include:

Special problems related to the analysis of marine samples
Sample preservation and storage
Optimizing sampling frequency
Computer programs for data processing
Data interpretation
Water quality criteria, standards, and enforcement
Quality control
Development and improvement of specific methods.

Physical and Chemical Methods Activity

The Physical and Chemical Methods Activity employs many of the "traditional" methods for analysis of pollutants in water and other media. These methods consist primarily of "wet" chemical or instrumental analysis. Because of the expansiveness and diversity of the methods, several subgroups have been defined to ensure technical capability and coverage of the methods available.

General Analysis Group

The General Analysis Group is concerned primarily with "wet" chemistry methods. Their interests, however, may overlap those of other groups within this activity, but may also cover methods that are not specifically covered by other groups. The areas of current interest are:

Automation of Colorimetric Procedures
Evaluation of Specific Ion Electrodes
Methodology Related to Taste and Odor Causing Substances
Analysis of Silts

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Analysis of Sludges
Nutrient Analysis
Determination of Total Phosphorus in Organic Samples
Methods for Measuring NTA (nitrilotriacetate).

Indications are that effluent analysis will soon be initiated and will continue to play an important part in the activities of the General Analysis Group.

Spectrographic Group

Although the name may imply rather restricted interests, the interests of this group actually extend beyond spectrographic methods. The instrumental methods of interest include visible, ultraviolet, infrared, and fluorescence spectroscopy, helium glow techniques, emission spectroscopy, atomic absorption, fluorescence spectrophotometry, and some wet chemical techniques. Pollutants of current interest are trace elements, primarily heavy metals. These are analyzed not only in the aquatic environment, but also in biological tissue, urine, soils, and plants. Because of the mercury crisis in 1970, much of the interest in this Group has centered on the analysis of mercury in waters, sediments, and aquatic organisms. However, other heavy metals, such as cadmium, arsenic, and lead, are expected to be of considerable importance in the coming year.

Although the characterization of oils falls in the domain of one of the other activities at AQCL, the spectroscopy group is interested in this area because one of the methods being considered for oil characterization is the analysis of trace metals in the oils. However, this interest is primarily related to the instrumentation involved in the analysis rather than the chemistry.

Organics Group

A large portion of the interest of the Organics Group revolves around chromatographic methods for analysis of polychlorinated biphenyls, organophosphorus pesticides, organic nitrogen compounds, organochlorine pesticides, nitrilotriacetate (NTA), and petroleum products. They are also interested in related laboratory techniques such as extraction methods, carbon adsorption methods for recovery of organic compounds, and operational techniques related to chromatography.

Biological Methods Activity

The abundance and composition of communities of aquatic organisms are useful in determining the presence or absence of certain conditions or contaminants in the environment. Methodology important to the two groups in this Activity, therefore, includes techniques for collecting and processing samples, counting and identifying the organisms, and evaluating and interpreting the data. Information related to the water quality requirements of the organisms and their sensitivity to toxic and nutritive substances is also of interest.

Benthos Group

The interest of this group is confined principally to the macroinvertebrates that live on or in the bottom of bodies of water. The macroinvertebrates are those invertebrates that are retained on a U. S. Standard No. 30 sieve (0.059 mm openings). Techniques now under development or evaluation include the use of artificial substrates and mechanical sampling devices. Current techniques used for sorting the macroinvertebrates from the debris in the samples are normally very tedious and time consuming and, therefore, need to be improved and streamlined by the use of stains and mechanical devices.

Plankton-Periphyton Group

The interests of this group are similar to those of the Benthos Group except that organisms of concern are generally microscopic and live on the bottom or within the water column. The organisms of concern consist of zooplankton, phytoplankton, diatoms, algae, protozoa, filamentous bacteria, and some fungi. The specific subjects of interest to this group are development of methods for measuring total plankton and periphyton biomass, methods of automatic phytoplankton counting, diatom identification, periphyton collection and identification, imp'oved methods of extracting, identifying, and quantitating algal pigment, and methods for measuring the effects of toxic effluents on natural communities of microorganisms.

Microbiological Methods Activity

The role of Microbiological Methods in water quality investigations is to develop new, improved, or modified procedures which will provide evidence of fecal pollution by the enumeration of certain bacterial indicator groups and to demonstrate the risk to public health by the presence of disease-causing microorganisms which are waterborne, such as bacteria, viruses, yeasts, and fungi.

The most common indicator groups which are found in large numbers in sewage are the total coliforms, fecal coliforms, and fecal streptococci. The densities of these microorganisms in water are indicative of fecal pollution. More rapid, accurate, and simple methods for detecting and counting these bacteria are presently being investigated. The search is continuing for other groups of microorganisms, such as Clostridia, Pseudomonas, enteropathogenic E. Coli, Streptococcus bovis, and others which may have potential as indicators of general or specific types of pollution.

There is a current need to develop procedures for the identification and enumeration of possible waterborne pathogens including Salmonella, Shigella, Brucella, Leptospira, Pasteurella, Vibrios, mycobacteria, and viruses.

Microbiological methodology has traditionally used cultural, biochemical, morphological, and serological tests. Interest is now centered on new techniques for the rapid identification and enumeration of indicators and pathogens. The interests of the Microbiological Methods Activity include: tests for the aforementioned microorganisms in fresh and marine waters, sediments, and soils; effluent monitoring; survival of microorganisms; sample methods and preservation; membrane filter techniques; biochemical tests; automation of methods; fluorescent antibody techniques; radioactive tracer studies; water quality standards; and computerized data handling.

Methods and Performance Evaluation Activity

The Methods and Performance Evaluation Activity functions somewhat differently from the rest of the activities within AQCL. Rather than developing analytical techniques, it is responsible for the validity and general applicability of the methods that have been suggested by other activities in AQCL and other EPA laboratories. An additional function is the continued evaluation of the performance of analysts in the various agency laboratories throughout the United States. Briefly, the official methods selected by EPA are evaluated in a controlled study by analysts in agency laboratories throughout the United States. The laboratories are informed of the test procedures and are supplied unknown samples containing various constituents. The analysts run the analyses and provide the results to the Methods and Performance Evaluation Activity. Evaluation of the analysts' results establishes the precision and accuracy of the method, and any interference or any other problems encountered. Based upon these results, the formal statements of precision and accuracy are prepared for each official EPA method.

The other primary function of this activity is to provide a continuing supply of reference samples for intralaboratory quality control to the analysts in agency, state, local and private laboratories.

The principal areas of interest to this Activity include: applied statistics; collaborative testing; interlaboratory quality control; evaluation of analytical methods and performance; statistical treatment of analytical data; computer programs for statistical analyses; quality control in the laboratory; experimental design, chemical, biological, and microbiological methodology. These interests cover a very large body of information. Therefore, the scope must be restricted to those segments which specifically relate to the interest of this Activity.

Instrument Development Activity

The main interest of this Activity is the development of instrument systems for continuous and remote monitoring of water quality parameters. These systems include not only the sensors which are used to measure the parameters, but also the ancillary equipment necessary for transporting the water from stream or lake to the sensors, and the data transmission and recording systems. The scope of the Instrument Development Activity covers intake systems - water lines, wells, motors, pumps, and mode of operation; sensors or probes - electrochemical, electrobiological, thermodynamic, mechanical, optical, and nuclear; data analyzers - analog and digital amplifiers, and output displays; recording systems - telemetry, data logging, and digital data processors; component specifications; and capabilities of small computers. There is currently a keen interest in the development of "new" probes for measuring previously unmonitored water quality parameters.

Concluding Statements on Scope

The foregoing discussion of the technical interests of the various Activities of the Analytical Quality Control Laboratory is indicative of the broad scope to be covered by an information center on analytical methodology.

Experience gained from operating other information centers at Battelle has shown that the scope of a center changes with shifts in the interests and activities of the user audience. Therefore, the foregoing statements of scope are not considered to be absolute, but rather form a basis for the initial establishment of an information base which will remain dynamic by responding to changes in interests and emphasis within the EPA program.

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SECTION VI

ACQUISITIONS

Since it is contingent upon knowledge of scope, the acquisitions program is initiated after the sphere of interest for an information analysis center has been established by the scoping and definition effort. It should be pointed out that, after the preliminary definition of scope, scoping and acquisition efforts are maximized if they are interactive. That is, when an initial knowledge of the scope of interest has been gained, the acquisitions phase should begin so that initial screening will generate questions which, when resolved, provide further definition of the scope. The initial activities connected with the scoping provided a firm basis for the acquisitions phase of the program.

The next step was to compare the sources cited by the AQCL staff with the holdings of the Battelle libraries. The sources cited by the AQCL staff and available at Battelle were given priority coverage in order to demonstrate to the AQCL staff the capability of an information program to obviate much of their individual activities related to coverage of the literature. In addition, as time permitted, the entire holding of current journals in the Battelle Main Library (about 2,500 titles) was reviewed to identify all sources available which might contain pertinent information. As a result, a total of about 105 journals and six abstract sources were regularly reviewed. An integral part of the acquisitions activity was the recording of the number of items of interest that occurred in a given journal over several months time. This record was analyzed to project the annual occurrence of pertinent articles from these sources alone. (See Appendix D). This projection was combined with other data to predict the total amount of journal literature that could be expected for an operational center.

During the study, additional important information sources were identified as off-shoots of other activities and as a result of contacts with the AQCL staff and efforts of the Project Officer. Since many of these were not readily accessible or sufficient funds were not available for coverage, they were not reviewed during the pilot study. These additional journals and abstract sources are listed in Appendix E and recommended for regular coverage by an operational Analytical Methodology Information Center.

In addition to the journal literature, concern was expressed at AQCL about Government research reports which are not brought to the attention of the AQCL staff. To cover these reports, the Government Reports Announcements (GRA) which is published by the National Technical Information Service, and the Technical Abstract Bulletin (TAB), which is published by the Defense Documentation Center, were reviewed on a regular basis. Significant material was identified through both of these resources. Approximately 147 reports were purchased from the National

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Technical Information Service for dissemination to AQCL. Economic restrictions did not permit coverage of the Atomic Energy Commission's Nuclear Science Abstracts (NSA) and NASA's Scientific and Technical Aerospace Reports (STAR), although some pertinent AEC reports were identified and obtained through the Battelle AEC Library facility and a computer search was made of the NASA holdings, and pertinent reports were ordered. Since the NASA search was largely unproductive, coverage of NASA reports was maintained through the Government Reports Announcements.

Additional reports and theses were identified by means of Dissertation Abstracts, journal screening and numerous other sources.

Data on the number of documents identified from the various sources during the pilot study have been used to project the total number of new items that could be expected annually from each source. These estimates are included in Table 1.

TABLE 1. NUMBER OF DOCUMENTS ACCESSIONED DURING THE PILOT STUDY AND ESTIMATE OF ANNUAL INPUT BY SOURCE.

Source	Total Accessioned on Pilot Study	Estimated Annual Input
Journals	927	1425
AQCL Reports	13	5
NTIS Reports	147	340
Other Reports (including theses)	58	60
Totals	1145	1830

SECTION VII

INFORMATION SYSTEM

The information system as described in this section is not limited to the hardware employed in the information handling. Rather, it includes all of the ancillary operations which are conducted so that the hardware portion of the system can function.

As stated in the section on ACQUISITIONS, the prime sources of information were identified early in the operations phase of the program. Subsequently, these sources were regularly reviewed for input to the information base.

Information Processing

Information processing as considered here begins after acquisition of a document. The main processing steps for the prototype Analytical Methodology Information Center consisted of:

(1) Document logging

(2) Abstracting and indexing

(3) Quality checking

(4) Typing drafts of abstracts

(5) Abstract editing

(6) Typing of the current awareness bulletin

(7) Typing of WRSIC abstracts

(8) Loading the computerized information system.

At this juncture, it should be pointed out that the information center had three responsibilities to satisfy regarding information processing: (1) publication of the current awareness bulletin, (2) provision of abstracted and indexed material to WRSIC, and (3) preparation of machine-readable input for the computerized information storage and retrieval system. These three requirements were satisfied by the processing procedures shown in Figure 5.

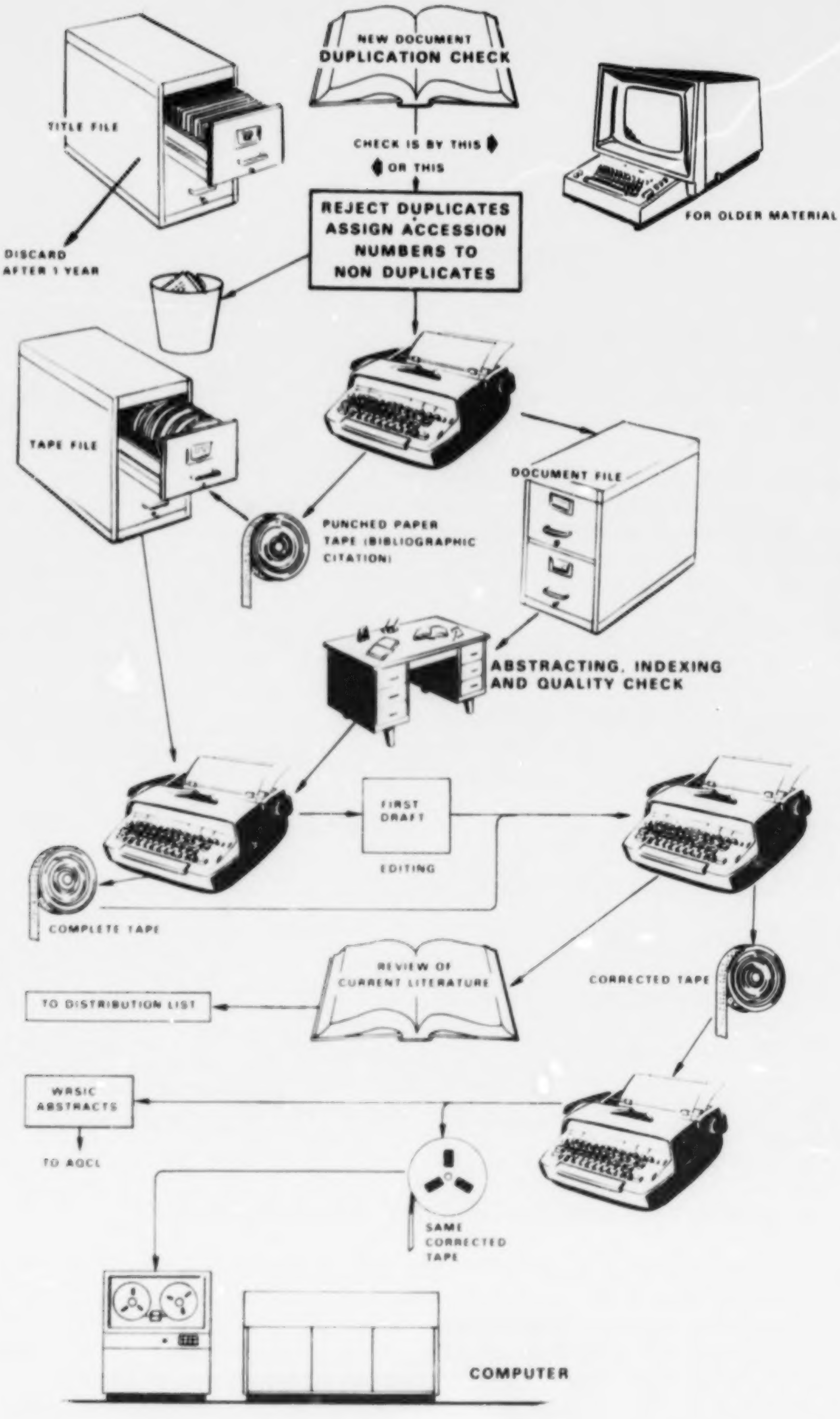

NEW DOCUMENT
DUPLICATION CHECK
TITLE FILE
CHECK IS BY THIS
OR THIS
FOR OLDER MATERIAL
REJECT DUPLICATES
ASSIGN ACCESSION
NUMBERS TO
NON DUPLICATES
DISCARD
AFTER 1 YEAR
TAPE FILE
DOCUMENT FILE
PUNCHED PAPER
TAPE (BIBLIOGRAPHIC
CITATION)
ABSTRACTING, INDEXING
AND QUALITY CHECK
FIRST
DRAFT
EDITING
COMPLETE TAPE
REVIEW OF
CURRENT LITERATURE
TO DISTRIBUTION LIST
CORRECTED TAPE
WRSIC
ABSTRACTS
TO AQCL
SAME
CORRECTED
TAPE
COMPUTER

FIGURE 5. DOCUMENT PROCESSING PROCEDURES IN THE ANALYTICAL METHODOLOGY INFORMATION CENTER

Document Logging

The first step in processing the acquired documents into the system consisted of assigning accession numbers and simultaneously preparing (a) bibliographic cards for filing by title, and (b) bibliographic portions of the WRSIC forms by filing by accession number. These steps were performed simply by typing the WRSIC form (see Figure 10a) and a carbon copy on a 5" x 8" card (see Figure 6). The title file, comprised of the bibliographic cards, was used for checking whether new acquisitions were duplicates of items already in the system; the partially completed WRSIC forms were used in subsequent preparation of abstracts, especially those for WRSIC.

The logging phase also included the first step in preparation of machine-readable input to the information system. Since typing was done on a paper-tape typewriter, punched tapes of the bibliographic information were prepared simultaneously. The paper tapes were filed for use in subsequent processing.

A paper-tape machine was chosen for two main reasons: (1) ease of sorting for specific abstracts, (2) capacity for long abstracts and many index terms. Other types of input devices may be considered in future operations.

Abstracting and Indexing

A major portion of the pilot operation effort was devoted to abstracting and indexing since these are the basic elements of information processing. The activity in this area was rather small at the inception of operations. However, as operations progressed and the need arose for input to the current awareness bulletin, additional staff effort was concentrated on abstracting. Consequently, during the pilot study, 470 documents, of a total of 1145 accessioned, were abstracted and indexed. The level of effort permitted on the study was insufficient for processing all the documents collected; therefore, at the termination of the operational portion of the study, AMIC had a backlog of 675 items to be abstracted.

Quality Checking

After abstracts and index terms were prepared they were quality checked as part of the effort to ensure the accuracy and adequacy of the abstracting and indexing. An important part of quality checking was vocabulary control which is described in the following paragraphs.

AMIC-1059

Wisconsin University, Milwaukee, Center for Great Lakes Studies

BIOLOGICAL EVALUATION OF ENVIRONMENTAL QUALITY, GREEN BAY, LAKE MICHIGAN,

Howmiller, R. P.,
Beeton, A. M.

Journal of the Water Pollution Control Federation, Vol. 43, No. 1,
p 123-133, January 1971. 8 fig, 2 tab, 18 ref.

FIGURE 6. SAMPLE OF BIBLIOGRAPHIC CARD

Vocabulary Control. Adequate indexing is mandatory if any information storage and retrieval system is to function satisfactorily. When the storage and retrieval is computerized, deep indexing is not sufficient; vocabulary control must also be applied. The most desirable method of vocabulary control is by use of a thesaurus. Therefore, the Water Resources Thesaurus, which was developed for WRSIC, was consulted by the indexers to provide at least partial vocabulary control. However, with the depth of indexing required for AQCL's purposes, the WRSIC thesaurus was not extensive enough to include many of the terms used. Consequently, much of the vocabulary control was based purely on the indexers' and quality checker's judgment and memory since no reference manual was available to cover these occurrences.

One product which resulted from building the index file on the computer was a listing of all the index terms used. This index list proved very useful in vocabulary control. It was used to identify and correct misspellings and inconsistencies such as the terms "agar" and "agars" shown in the samples reproduced as Figure 7.

Furthermore, the listing can serve as a dictionary when the information base is queried. In actual operation, inconsistencies and misspellings cause no loss of information since the improper terms can be identified by making stem searches. Stem searches could be made on the Battelle information system by typing portions of a word followed by an asterisk, e.g., "analyt*". The computer would then list all the terms in the index beginning with those letters. However, their existence requires that additional terms be employed to get a complete response to a query.

As discussed in a later section on WRSIC Indexing Versus Indexing for AQCL, page 45, the Project Officer requested that indexing be as specific as possible. However, when the computerized information system was demonstrated, the terms used in the queries were many times generic terms such as "macroinvertebrates", "pesticides", and "diatoms". Since indexing was done primarily on specifics, responses on generic searches were not always all inclusive. These experiences demonstrated the need for another aspect of vocabulary control - generic posting. (When a document number is connected to an index term, it is said to be "posted" on that term.) Since an exhaustive thesaurus is not presently available to cover the subject area of interest, manual generic posting should be incorporated in the indexing procedure. This discussion serves to illustrate the desirability of developing and incorporating in an information system a suitable thesaurus. The inclusion of a thesaurus permits the indexer to concentrate on specific, narrow aspects of each document. The computer can be programmed to post to the proper generic terms. Manual generic posting requires considerable effort on the part of the indexer, both intellectually and in performing manual "look-up". Future development of AMIC should incorporate attention to thesaurus development and vocabulary control.

Another aspect of vocabulary control became obvious during the demonstration of the system at AQCL. This was the need for elimination of synonymous terms such as "analytical methods" and "analytical techniques".

```
COMMENCING TO BUILD FILE
        ABLABESMYIA
        ABLABESMYIA SP
        ABSORPTION
        ACARINA
        ACCEPTANCE TESTING
        ACCIDENTS
        ACETATES
        ACETIC ACID
        ACETONE
        ACETONES
        ACHIRUS LINEATUS
        ACHROMOBACTER
        ACHROMOBACTER AMBIGUUM
        ACHROMOBACTER DESMOLYTICUM
        ACHROMOBACTER FERMENTATIONES
        ACHROMOBACTER SP
        ACHROMOBACTER TIOGENS
        ACHROMOBACTER UBIQUITUM
        ACIDIC WATER
        ACIDITY
        ACIDS
        ACRONEURIA
        ACRONEURIA SP
        ACTINASTRUM HANTZSCHII
        ACTINOMYCETES
        ACTIVATED SLUDGE
        ADENOSINE TRIPHOSPHATE
        ADENOVIRUS
        ADSORBENTS
        ADSORPTION
        AERATION
        AEROMONAS HYDROPHILIA
        AETHALOPTERA ROSSICA
        AGAPETUS COMATUS
        AGAR
        AGARS
        AGRAYLEA MULTIPUNCTATA
        AGRICULTURAL WATERSHEDS
        AGRYLEA PALLIDULA
        ALCALIGENES
        ALCALIGENES FAECALIS
        ALCOHOLS
        ALDRIN
        ALGAE
        ALGICIDES
        ALKALINITY
        ALKENE SULFONATE
        ALKYL PHENOLS
        ALKYL BENZENE SULFONATES
        ALKYLPHENOLS
        ALLEGHENY RIVER
        ALLEGHENY RIVER (PENNSYLVANIA)
        ALPHA-OLEFIN SULFONATE
        ALTERNARIA
CLOSTRIDIUM SPOROGENES
CLOSTRIDIUM TERTIUM
CLOSTRIDIUM TETRAMORPHIUM
COAST GUARD
COBALT
COBALT RADIOISOTOPES
COCCONEIS PLACENTULA
COCEOLITHUS HUXLEYI C
COD
COELOPIDAE
COELOTANYPUS CONCINNUS
COHO SALMON
COLEOPTERA
COLEPTERA
COLIFORMS
COLLABORATIVE STUDIES
COLLAMBOLA
COLOR
COLORADO
COLORADO RIVER
COLORIMETRY
COLUMBIA RIVER
COLUMBIA RIVER (WASHINGTON)
COMMUNICATION
COMPLEXOMETRIC TITRATION
COMPUTER MODELS
COMPUTER PROGRAMS
COMPUTERS
CONDUCTION
CONDUCTIVITY
CONNECTICUT
CONNECTICUT RIVER
CONTENT KEYS (FLORIDA)
COOS BAY (OREGON)
COPEPODS
COPPER
COPPER COMPOUNDS
COPPER SALTS
CORBICULA FLUMINEA
CORDYLOPHORA LACUSTRIS
CORE DRILLING
CORIXIDAE
COROTHIUM SPINICOLA
CORRELATION ANALYSIS
CORROSION
CORYNEFORM SP
COSCINODISCUS
COST COMPARISONS
COSTS
COULTER COUNTER
COUNTING
CRABS
CRANGONYX
CRICOTOPUS BICINCTUS
CRICOTOPUS SPP
CROAKER
```

FIGURE 7. SAMPLE OF AMIC INDEX TERM LISTING

Eliminating synonymous terms is more difficult than eliminating misspellings and inconsistencies since synonymous terms often are very much different in spelling and consequently do not appear near each other in an alphabetical listing. Consequently, more intellectual effort and time are required for controlling synonymous terms. The experience gained during the pilot study suggests that vocabulary control as discussed above definitely should be incorporated as a vital function in an operational information center.

Typing Drafts of Abstracts

The next step in processing was to type first drafts of the abstracts to make up the current awareness bulletin. In this first typing, the abstracts were typed individually and a punched paper tape prepared simultaneously.

Abstract Editing

Upon completion of typing, the first draft of the abstract was edited for typographical, grammatical, and any other errors.

Typing of the Current Awareness Bulletin

To prepare the current awareness bulletin, the punched paper tape of the bibliographic portion of a document and of the draft were rerun while the edited draft copy was consulted by the machine operator. The automatic retyping was interrupted when corrections were to be made. The products of this typing were the camera-ready copy of the "Reviews" and a corrected paper tape for use in typing the WRSIC abstracts and as input to the computerized information storage and retrieval system.

Typing of WRSIC Abstracts

The corrected paper tapes which were prepared during the typing of the current awareness bulletin were simply rerun on the WRSIC abstract forms to prepare them for WRSIC.

Loading the Computerized Information System

Once a corrected paper tape had been prepared, it was a relatively simple task to use it as input to the computer since programs are available which convert punched paper tape to computer language.

Use of the paper tape typewriter minimized final typing time and preparation time for WRSIC abstracts and largely eliminated keypunching as a means of preparing computer input. The multiple use of the paper tape, therefore, results in considerable cost savings since each one of these preparations would have been required in fulfilling the obligations of the information center and if provided individually would have cost much more.

Potential of Providing Machine Readable Input to Other Information Centers

As stated in the preceding paragraphs, the punched paper tape that was prepared during the information processing proved valuable as machine-readable input into the computerized information system. This application suggests a further possible function of the information center - providing machine-readable input to other information bases, namely, WRSIC and/or EPA's Technical Information and Management Planning System (TIMPS). Since the Analytical Methodology Information Center would likely prepare computer input for itself on a regular basis, this input could probably be used directly by other systems. In the mode that the pilot center operated, it would be possible to provide punched paper tapes, punched cards, or magnetic tape.

There are a number of impediments to direct system interaction, the main ones resulting from differences in the operating systems of computers. Therefore, direct system interaction should be carefully studied to determine its utility. Such a study would require that the system outside the one being used by the Analytical Methodology Information Center be investigated to uncover areas of incompatibility and find approaches for dealing with them.

Computerized Information Storage and Retrieval System

The proposal submitted by Battelle to design and operate a prototype information center suggested that an optical coincidence retrieval system be employed for a demonstration system. It was soon recognized, however, that such a system would not satisfy the applications anticipated by the AQCL staff, which are to provide a means for direct access to the system at AQCL and possibly at other laboratories in the future. The main reasons for rejecting the optical coincidence system were that (1) updating would entail either recalling all the cards or providing multiple sets for exchanging and updating and (2) the capacity of the equipment probably would be insufficient to handle the broad scope of AQCL's interests. Therefore, plans were shifted early in the program to include a demonstration of the information base on a computerized information storage and retrieval system.

Description of the Battelle Computer System

In March, 258 abstracted and indexed items were loaded on Battelle's Control Data Corporation 6400 computer. The information package employed on the pilot operation is called BASIS-70 and was developed by Battelle. As used on the pilot operations, the system provided the following capabilities:

(1) Title word searches

(2) Author searches

(3) Facility searches

(4) Index term searches

(5) Boolean logic

(6) Display of any or all information fields in any order. (The fields are: (1) accession number, (2) facility, (3) title, (4) author(s), (5) bibliographic data, (6) index terms, (7) abstract.)

(7) "Nearby term" and stem displays

(8) Display of any portion of any specific document by means of accession number.

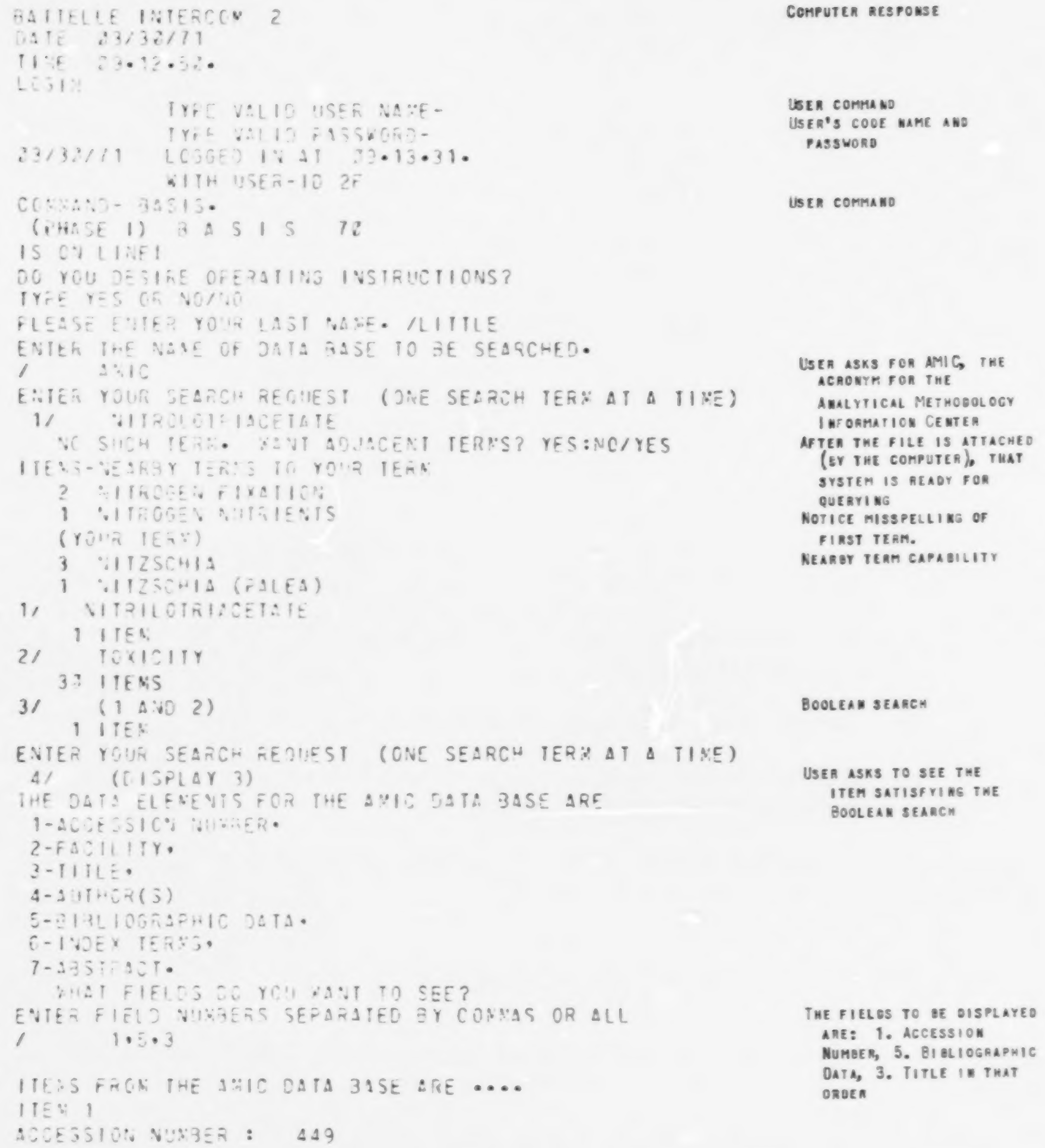
The system may be queried by acoustical teletype terminal, hard-line teletype terminal, or cathode ray tube (CRT).

Sample Searches of the Computerized Information System

To demonstrate some of the aforementioned capabilities, samples of two actual searches with descriptions of the procedures are shown in Figure 8.

In this particular example, the searcher first desired to find references to the literature having to do with the toxicity of nitrilotriacetate. He was able to accomplish this by making a Boolean search of all documents within the AMIC data base which discussed both toxicity and nitrilotriacetate, as shown in Figure 9a. As a result of the search, he identified the article "A Screening Technique for Estimating Copper Toxicity to Estuarine Phytoplankton".

Of course, as the AMIC data base grows, the number of "hits" (or responses satisfying the search criteria), for such a simple search may become sufficiently large that he might desire to further narrow his search by adding the term "Phytoplankton". See Figure 9b.



```
BATTELLE INTERCOM  2
DATE  03/30/71
TIME  09.12.52.
LOGIN
             TYPE VALID USER NAME-
             TYPE VALID PASSWORD-
03/30/71     LOGGED IN AT  09.13.31.
             WITH USER-ID 2F
COMMAND- BASIS.
 (PHASE I)  B A S I S   72
IS ON LINE!
DO YOU DESIRE OPERATING INSTRUCTIONS?
TYPE YES OR NO/NO
PLEASE ENTER YOUR LAST NAME. /LITTLE
ENTER THE NAME OF DATA BASE TO BE SEARCHED.
/      AMIC
ENTER YOUR SEARCH REQUEST  (ONE SEARCH TERM AT A TIME)
 1/     NITROLOTRIACETATE
   NO SUCH TERM.  WANT ADJACENT TERMS? YES:NO/YES
ITEMS-NEARBY TERMS TO YOUR TERM
   2  NITROGEN FIXATION
   1  NITROGEN NUTRIENTS
   (YOUR TERM)
   3  NITZSCHIA
   1  NITZSCHIA (PALEA)
1/    NITRILOTRIACETATE
    1 ITEM
2/     TOXICITY
   33 ITEMS
3/     (1 AND 2)
    1 ITEM
ENTER YOUR SEARCH REQUEST  (ONE SEARCH TERM AT A TIME)
 4/     (DISPLAY 3)
THE DATA ELEMENTS FOR THE AMIC DATA BASE ARE
 1-ACCESSION NUMBER.
 2-FACILITY.
 3-TITLE.
 4-AUTHOR(S)
 5-BIBLIOGRAPHIC DATA.
 6-INDEX TERMS.
 7-ABSTRACT.
   WHAT FIELDS DO YOU WANT TO SEE?
ENTER FIELD NUMBERS SEPARATED BY COMMAS OR ALL
/       1.5.3

ITEMS FROM THE AMIC DATA BASE ARE ....
ITEM 1
ACCESSION NUMBER :   449
```

COMPUTER RESPONSE

USER COMMAND

USER'S CODE NAME AND PASSWORD

USER COMMAND

USER ASKS FOR AMIC, THE ACRONYM FOR THE ANALYTICAL METHODOLOGY INFORMATION CENTER

AFTER THE FILE IS ATTACHED (BY THE COMPUTER), THAT SYSTEM IS READY FOR QUERYING

NOTICE MISSPELLING OF FIRST TERM.

NEARBY TERM CAPABILITY

BOOLEAN SEARCH

USER ASKS TO SEE THE ITEM SATISFYING THE BOOLEAN SEARCH

THE FIELDS TO BE DISPLAYED ARE: 1. ACCESSION NUMBER, 5. BIBLIOGRAPHIC DATA, 3. TITLE IN THAT ORDER

FIGURE 8. SAMPLE SEARCHES OF THE AMIC INFORMATION BASE WITH DESCRIPTIVE NOTES

```
BIBLIOGRAPHIC DATA : JOURNAL OF THE WATER
     POLLUTION CONTROL FEDERATION (RES• SUPP
     LE•)• VOL• 42• NO• 8• PART 2• P R273-R27
     6• AUGUST 1972•  1 FIG• 5 TAB• 17 REF•
TITLE : A SCREENING TECHNIQUE FOR ESTIMATING COP
    PER TOXICITY TO ESTUARINE PHYTOPLANKTON•
FINISHED WITH PRINTOUT•  CONTINUE ENTERING SEARCH TERMS•
ENTER YOUR SEARCH REQUEST (ONE SEARCH TERM AT A TIME)
 1/    (DISPLAY (684))
```

USER REQUESTS A SPECIFIC DOCUMENT

```
ENTER FIELD NUMBERS SEPARATED BY COMMAS OR ALL
/      1•2•3•4•5•7
ITEMS FROM THE AMIC DATA BASE ARE •••••
ITEM 1
ACCESSION NUMBER :    684
FACILITY : NORTH CAROLINA UNIVERSITY• CHA
    PEL HILL• WATER RESOURCES RESEARCH INSTI
    TUTE
TITLE : THE RELATIVE SIGNIFICANCE OF PHOSPHORUS
    AND NITROGEN AS ALGAL NUTRIENTS•
AUTHOR(S) : WEISS• CHARLES M•
BIBLIOGRAPHIC DATA : ESE PUBLICATION NO•
    240• REPORT NO• 34• JUNE 1972• 54 P• 27
    FIG• 8 REF• PB 194 254•
ABSTRACT     :  EXAMINATION OF THE INTERACTIO
   N BETWEEN NITROGEN AND PHOSPHORUS SPECIE
   S RELATIVE TO ALGAL GROWTH IN SEVERAL F
   RESHWATER ENVIRONMENTS OF DIFFERING TROP
   HIC STATE HAS MADE POSSIBLE THE ESTABLIS
   HMENT OF THE RELATIVE SIGNIFICANCE OF TH
   ESE ELEMENTS AS ALGAL NUTRIENTS•  THE ALG
   AL ASSAY WAS CARRIED OUT USING MEMBRANE
   FILTERED SAMPLES DERIVED FROM A SERIES O
   F OXIDATION PONDS RECEIVING SECONDARY EF
   FLUENT FROM A TRICKLING FILTER PLANT AND
    FROM SAMPLES DERIVED FROM SAMPLING POIN
   TS ON THE NEW HOPE AND HAW RIVERS•  THE L
   ATTER REPRESENTED A SERIES OF CHANGING R
   IVER QUALITIES WITH PARTICULAR RESPECT T
   O THE OXIDATION STATES OF NITROGEN AND P
   HOSPHORUS•  THE ALGAL ASSAY USED PURE CUL
   TURES OF FIVE SPECIES: EUGLENA ROSTIFERA
   • CHLAMYDOMONAS REINHARDTII• ' PANDORINA
   MORUM• SCENEDUSMUS QUADRICADUA• AND CHL
   ORELLA ELLIPSOIDER•  THE RESULTS OF BOTH
   CHEMICAL AND BIOLOGICAL ASSAY EXAMINED T
   HROUGH MULTIPLE REGRESSION ANALYSIS OF T
   HE INDEPENDENT VARIABLE INVOLVED IN THE
   ALGAL ASSAY AS WELL AS A QUADRATIC ANALY
   SIS OF COVARIANCE OF NH 3 -N• NO 3 -N AN
```

FIGURE 8. SAMPLE SEARCHES OF THE AMIC INFORMATION BASE WITH DESCRIPTIVE NOTES (Continued)

```
        D PO 4 -P ESTABLISHED THE RELATIVE SIGNI
        FICANCE OF THE NITROGEN AND PHOSPHORUS S
        PECIES IN WATER CONTAINING HIGH CONCENTR
        ATIONS OF THESE ELEMENTS. CONCENTRATIONS
         NORMALLY FOUND IN DISCHARGES FROM BIOLO
        GICAL WASTE TREATMENT PLANTS AND FOLLOWI
        NG DILUTION IN RECEIVING STREAMS. UNDER
        THESE CIRCUMSTANCES IT HAS BEEN SHOWN THE
        AT THE QUANTITY OF NITROGEN RATHER THAN
        THAT OF PHOSPHORUS DETERMINES THE BIOMAS
        S OF ALGAE THAT MIGHT BE EXPECTED TO GRO
        W.  IT WOULD THUS APPEAR THAT THE QUESTIO
        N OF ALGAL NUTRIENTS TAKES ON A SOMEWHAT
         MORE FORMIDABLE DIMENSION DUE TO THE CO
        NSIDERABLY GREATER DIFFICULTY IN REMOVIN
        G IN SIGNIFICANT AMOUNTS THE NITROGEN TH
        AT IS NORMALLY FOUND IN MUNICIPAL WASTEW
        ATERS.
FINISHED WITH PRINTOUT. CONTINUE ENTERING SEARCH TERMS.

16/      (QUIT)                                                     USER TERMINATES SEARCH
    B A S I S  70   HAS
ENJOYED SERVING YOU.
DO YOU HAVE ANY COMMENTS?
YES:NO/NO
(DONT FORGET TO "LOGOUT." BEFORE DISCONNECTING.)
GOODBYE..............


10.32.53.END    BASIS                                               USER LOGS OUT
COMMAND- LOGOUT.
CP TIME      1.916 SEC.
PP TIME  128.300 SEC.
 03/30/71  LOGGED OUT AT 10.33.10<
```

FIGURE 8. SAMPLE SEARCHES OF THE AMIC INFORMATION BASE WITH DESCRIPTIVE NOTES (Continued)

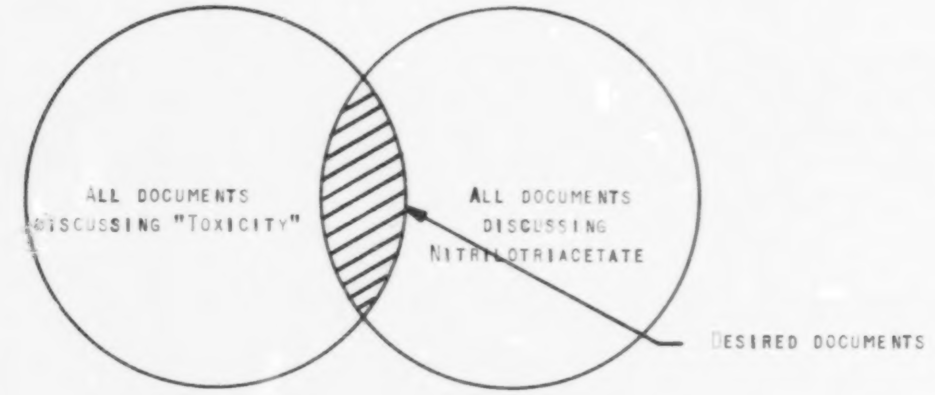

ALL DOCUMENTS
DISCUSSING "TOXICITY"
ALL DOCUMENTS
DISCUSSING
NITRILOTRIACETATE
DESIRED DOCUMENTS

FIGURE 9a. A SIMPLE BOOLEAN SEARCH STRATEGY USING TWO TERMS

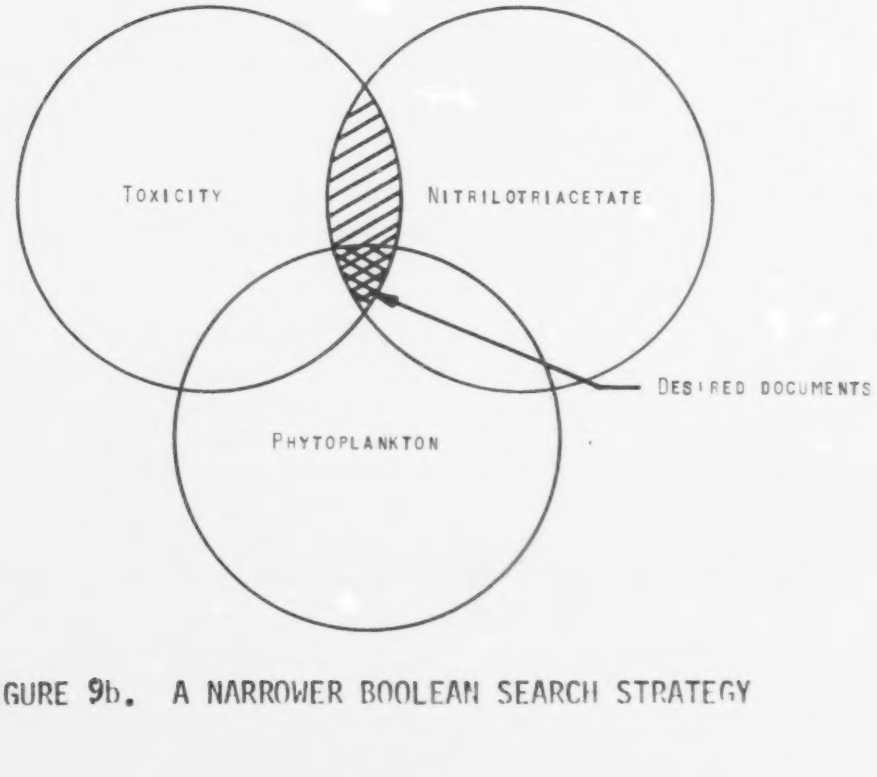

TOXICITY
NITRILOTRIACETATE
DESIRED DOCUMENTS
PHYTOPLANKTON

FIGURE 9b. A NARROWER BOOLEAN SEARCH STRATEGY

In the second search, he requested the display of a particular document with which he was familiar. Other approaches he might have used were author or the presence of a given word in the title. These too, could have been used in conjunction with Boolean search strategies, had he desired.

The sample searches demonstrate that the logic for this system is extremely simple, permitting the average user to command the system with a minimum of instructions. Indeed, the average user is frequently able to take command of this system within four or five minutes.

Of course, there are other capable information programs available. It is not the intent, here, to evaluate or compare various information storage and retrieval systems. Rather, the intent is to illustrate the state of the art of such systems and to demonstrate their utility in serving a user audience such as AQCL.

Demonstration of the AMIC Information System

Although some 470 items were abstracted and indexed, time constraints permitted loading only 258 of the items on the computerized information system for demonstration to the AQCL staff. The Battelle researchers believed that the system should be demonstrated to give the AQCL staff a "feel" for the potential capabilities of the information center.

The demonstration did not consist of "canned" searches, but began with one of the Battelle staff making a sample search, with the AQCL staff subsequently making searches of their own with the Battelle staff providing guidance.

Even with only 258 items in the system, the users frequently got hits on their queries. The demonstration pointed up the simplicity of using the system, since those of the AQCL staff who had the opportunity were able to successfully query the information base with minimal coaching. As a result, the AQCL staff was enthusiastic not only about the system, but also about the content and potential value of the information base itself.

Computer Storage Required for the Demonstration System

One uncertainty which is difficult to estimate and has an important effect on operations costs is the amount of computer storage space required for the information base. To get a better estimate of these values, the storage required for the 258 sample abstracts was analyzed. The results showed that each item averaged 2,850 characters (one character requires one unit of storage space) for the abstract and bibliographic information and 1,720 characters for index terms, for a total of 4,570 characters/item. It should be noted that some of this storage space is required for the computer operating system. The system requirements will decline relative to the total amount of information as additional items are loaded into the system. Likewise, additional postings on index terms now in the system will require a smaller amount of additional storage. These facts do not necessarily imply that total storage per item will diminish in the future. It is likely that it will remain approximately the same or increase since there is a possibility that abstracts will increase in size, indexing may be expanded (primarily by hierarchical posting), and features will be added to the computer system, thereby adding to storage space requirements. Consequently, costing for the operational center was based on an average number of characters per item which was greater than that of the sample documents.

Interface With the Water Resources Scientific Information Center (WRSIC)

As the "Center of Competence for Methods for Chemical and Biological Identification and Measurement of Pollutants", it is the responsibility of the Analytical Quality Control Laboratory to identify, abstract, and index information on analytical methodology for inclusion in the Water Resources Scientific Information Center (WRSIC). As part of the pilot operation of the Analytical Methodology Information Center (AMIC) it became Battelle's responsibility to provide this input to WRSIC as well as to investigate ways in which the WRSIC/AQCL/AMIC interactions could occur in the most beneficial way.

Brief Review of the Water Resources Scientific Information Center

At this point a brief review of WRSIC, its function, and its operations is desirable. WRSIC was established by the Secretary of the Interior under the Office of Water Resources Research on January 25, 1966. Initial funding of WRSIC was made in FY 1968. The objectives of WRSIC, as stated by the Manager, Raymond A. Jensen,(Reference 8) are:

(1) To serve as a focal point for national water resource technical information activities

(2) To initiate efforts to coordinate and complement existing technical information services

(3) To provide central operation of such water resource technical information services as can be best accomplished on a nationwide level

(4) To insure rapid flow of technical information to interested individuals and agencies

As of this writing, WRSIC has established 15 centers which will provide inputs to the system in specific technical areas of competence as shown in Table 2. It is the responsibility of these centers to provide a comprehensive coverage of all published material related to water resources in their particular subject area. These and other centers which will be established are to furnish the abstracting and indexing services which will provide the material to make up the water resources data base.

Visit to the Water Resources Center (University of Wisconsin). During the course of the project, the Project Officer deemed it desirable that the researchers visit another center of competence to investigate its operations. Consequently, a visit was made to the Water Resources Center at the University of Wisconsin to discuss the Eutrophication Information Program which is the WRSIC Center of Competence in Eutrophication.

The Eutrophication Program is one of the projects of the Water Resources Center and is funded by grant money from OWRR, U. S. Department of Agriculture, Soap and Detergent Association, and EPA. It consists of the information activity, which provides abstracts for WRSIC, and 9-10 research projects.

In this activity a graduate student screens Current Contents to identify articles of interest. Copies are then requested from the libraries at the University. Those identified as pertinent input to WRSIC are abstracted and indexed by two retired professionals. A typist-editor corrects, checks index terms, types the abstracts and mails them to WRSIC. The Center is obligated to provide WRSIC with 40 abstracts/month which is 35-40% of what is collected.

The abstracts which are prepared for WRSIC and bibliographic citations of the other articles identified are used to make up "Eutrophication Abstracts" which are distributed to about 2,100 persons.

In addition to the document processing, the Eutrophication Program publishes technical reviews, such as their recent ones entitled "Eutrophication" and "Algicides", about twice a year. These are generally prepared by technical specialists at the University.

Establishment of AMIC/WRSIC Interface. The interaction between AMIC and WRSIC began with a visit to WRSIC by the Battelle staff and the AQCL Project Officer for a briefing on the WRSIC operation. Subsequently, work was begun to provide input, in the WRSIC format, to the WRSIC information system.

The WRSIC instructions for abstracting and indexing which are reproduced in Appendix F were thoroughly reviewed before preparation of abstracts was begun by the Battelle staff. While these instructions are concise and complete, the interpretation of the instructions does require familiarity with the WRSIC system. Consequently, as abstracting and indexing

TABLE 2. WRSIC CENTERS OF COMPETENCE AND THEIR SUBJECT COVERAGE(Reference 7, 9)

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the EPA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.
- Water well construction technology at the National Water Well Association.

Supported by the Environmental Protection Agency in cooperation with WRSIC.

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.
- Agricultural livestock wastes at the Department of Agricultural Engineering of Iowa State University.
- Methods for Chemical and Biological Identification and Measurement of Pollutants, Analytical Quality Control Laboratory at Cincinnati, Ohio.

progressed, procedural questions which were not covered by the instructions were resolved by telephone discussions with the WRSIC staff. In addition, edited copies of abstracts submitted by Battelle were returned by WRSIC to Battelle for review. The provision of these edited abstracts in the early phase of the work largely eliminated further format problems.

The relationship with WRSIC was maintained throughout the operations phase of the program and proved beneficial for resolving additional problems.

After the development of a thorough understanding of WRSIC input procedures, all official transmittals of abstracts to WRSIC were channelled through AQCL, since it is officially the center of competence in analytical methodology. This step provided further quality control of the input, although somewhat slowing the procedure.

WRSIC Provision of Abstracts Before Publication in "Selected Water Resources Abstracts". An expressed interest by the Project Officer in a program at the University of Washington entitled "Water Quality Requirements for Marine and Fresh Water Aquatic Organisms" provided further opportunity to interact with WRSIC. After discussions with the manager of WRSIC, arrangements were made by Battelle for WRSIC to provide copies of the input from the University of Washington program before publication in WRSIC's Selected Water Resources Abstracts. These copies were forwarded to the Project Officer, thereby providing him with the material 2-3 months in advance.

WRSIC Interactive Computer System. During 1970, the WRSIC information base was loaded, on a trial basis, on Gipsy (Generalized Information Processing System) at the University of Oklahoma for remote querying by EPA personnel throughout the U. S. The staff of the computation center at Battelle began to investigate the possibility of direct interaction between WRSIC's interactive system and Battelle's computer system. However, the ending of WRSIC's trial period and the reorganization of the Department of Interior and organization of the Environmental Protection Agency, which left WRSIC's and EPA's relationships uncertain, precluded any detailed studies along these lines. If AQCL retains its position as a WRSIC center of competence, the feasibility of a directly interactive system should be investigated.

WRSIC Computer System Interaction With an Analytical Methodology Information Center. The abstracted and indexed material that is provided to WRSIC by its centers of competence is keypunched and input into an IBM 360-65 computer. This computer may be used to make batch searches and is used on a regular basis to provide the camera-ready copies of the index and to drive a text composer which prints abstracts for the Selected Water Resources Abstracts. The machining of this input is a very expensive and time consuming phase of putting the information on the computer. Since the abstracts prepared on an operational AMIC would also be machined for input into a computer system (see section entitled *Potential of Providing Machine-Readable Input to Other Information Centers*), thorough consideration should be given to the possibility of providing this machine-readable input directly to WRSIC rather than providing typed abstracts.

WRSIC Indexing Versus Indexing for AQCL

One difficulty that occurred during the abstracting effort was that the Analytical Methodology Information Center was "serving two masters" regarding indexing. Because of the broad scope of interest at WRSIC, the need is for broader, more general, index terms, possibly limited to 10-15 terms on the average. On the other hand, the technical needs of the AQCL staff specify that indexing be very deep or detailed, especially regarding biological and microbiological species names. The need for this detail increased the number of index terms to an average of about 32 terms/per abstract (in some cases to as high as 200 for a given document). To satisfy the requirements of both groups, the reports were first indexed in detail. Additional terms of a general nature were then added to cover many of the specific terms. For example, a document indexed for WRSIC might contain the following terms:

> Algae, Ohio, Euglena, Cuyahoga River (Ohio), Chlorophyta, Chrysophyta, Cyanophyta, Rhodophyta.

The same document indexed for AQCL purposes, however, would contain these terms:

> Algae, Ohio, Euglena, Cuyahoga River (Ohio), *Cladophora glomerata*, *Aphanochaete nepens*, *Rhizoclonium hieroglyphicum*, *Euglena gracilis*, *Vaucheria sessilis*, *Tribonema bombycinum*, *Oscillatoria nigra*, *Oscillatoria himosa* Chlorophyta, Chrysophyta, Cyanophyta, Rhodophyta.

Since indexing for AQCL in most cases included the terms for WRSIC plus additional terms, indexing was done to meet AQCL requirements. It was then possible for WRSIC editors to strike out any detailed terms that they deemed inappropriate for their system.

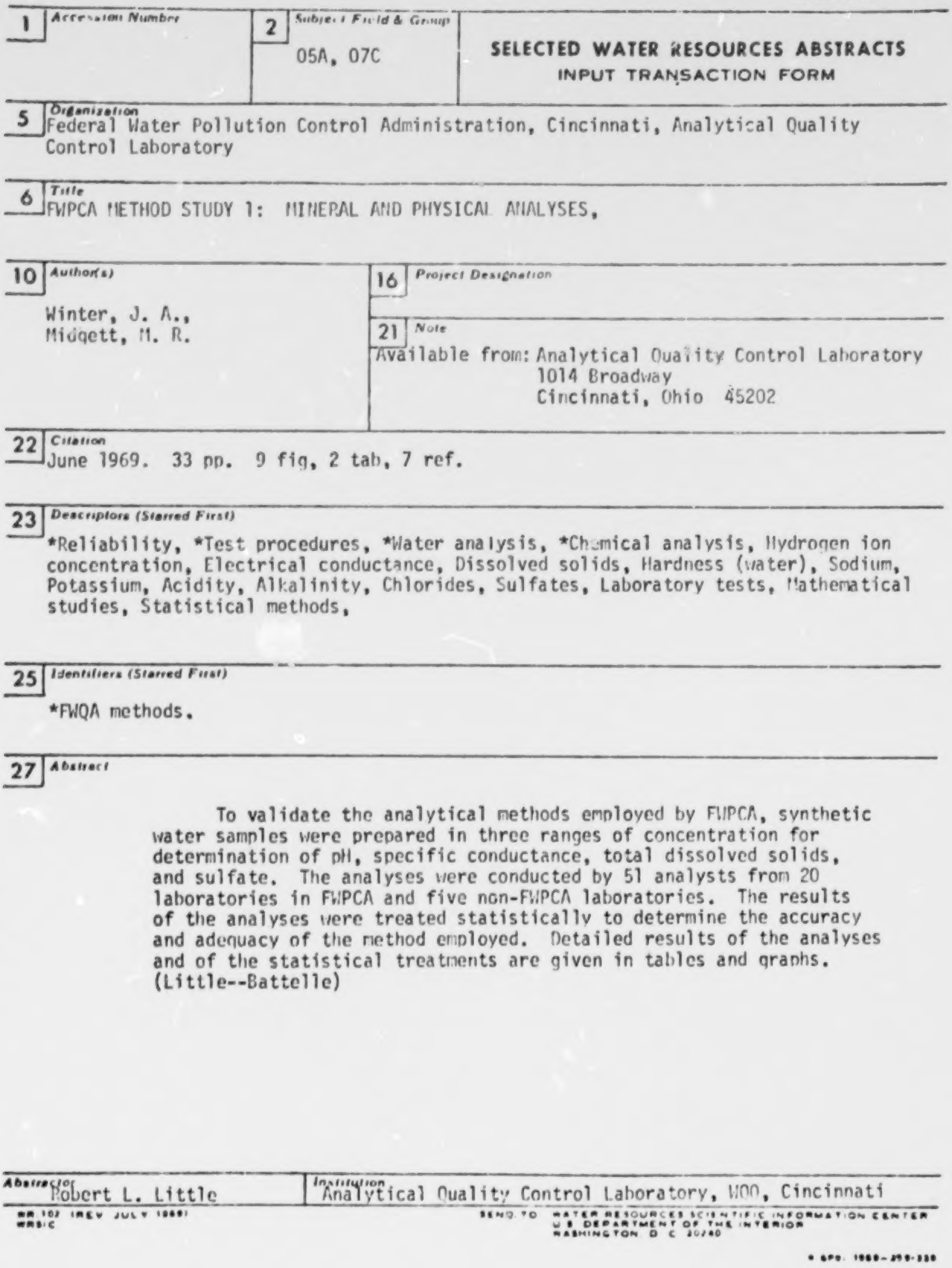
Input of Abstracts to WRSIC

As stated earlier, one of the functions of the Analytical Methodology Information Center, as specified in the contract, was to help fulfill AQCL's role as a center of competence by providing abstracts with index terms to WRSIC. The various types of input provided are described in the following paragraphs.

AQCL Reports and Technical Papers as Inputs to WRSIC. During the course of the pilot study, a special effort was made to assure that all AQCL published reports and technical papers (or as many as possible) were represented in WRSIC. To this end, during the early operation phase, WRSIC was requested to survey its data base for all publications by the staff of AQCL. Only 2 of 13 AQCL reports were identified as being in WRSIC. In addition, only 3 of 26 papers and journal articles authored by AQCL staff members appeared in WRSIC. Therefore, a special effort was undertaken to process all known AQCL publications. Because of time limitations, five journal articles authored by the AQCL staff were not submitted to WRSIC. One AQCL report was not submitted because it described a provisional method and hence was not approved for public announcement.

The responsibility for inputting AQCL reports into WRSIC should be a routine assignment for an established Analytical Methodology Information Center. Two copies of each AQCL report should be automatically distributed to the center; one for retention by the center and one for forwarding with the abstract to WRSIC. In addition, the inclusion into WRSIC of other EPA reports on analytical methodology could be assured by arranging with the individual laboratories to distribute their reports directly to the information center. This arrangement would serve two functions: (1) it would assure that the reports were publicly announced (in the Selected Water Resources Abstracts), and (2) it would be a means whereby the information center would have rapid access to EPA reports. Such an arrangement could be initiated by announcement in the AQCL Newsletter which is published quarterly and distributed to about 5,000 persons, both within and without EPA.

Abstracts Provided WRSIC During the Pilot Study. The first abstracts prepared by the AMIC staff were mailed to WRSIC during September 1970. Subsequent abstracts, which were prepared first for the "Reviews" and then typed for WRSIC, were mailed to AQCL for review and forwarding to WRSIC by the Project Officer. During the operational phase of the program, 115 indexed and abstracted documents along with hard copies were provided for WRSIC. Typical examples are shown in Figures 10a and 10b. As shown in Table 3, the WRSIC input consisted of journal literature, one Government research report and AQCL reports. One fact which should be emphasized is that the number of abstracts provided WRSIC does not represent the total number of documents abstracted during the pilot study. The AQCL scope statement, as written for this report, demonstrates that certain technical subjects of interest to the AQCL staff would not be considered to fall within WRSIC's areas of interest. A specific example of such a subject would be specifications for operational amplifiers. For the WRSIC point of view, this subject in itself is not related to analytical methods related to the aquatic environment. However, from the AQCL point of view a specific operational amplifier may, because of its capabilities, be the ideal component for a remote monitoring station. Because of this divergence in interests, not all documents accessioned by AMIC during the pilot study were considered to be suitable input to WRSIC. Only those which would be considered methodology from the WRSIC viewpoint were submitted as input.



1 Accession Number

2 Subject Field & Group
05A, 07C

SELECTED WATER RESOURCES ABSTRACTS
INPUT TRANSACTION FORM

5 Organization
Federal Water Pollution Control Administration, Cincinnati, Analytical Quality Control Laboratory

6 Title
FWPCA METHOD STUDY 1: MINERAL AND PHYSICAL ANALYSES,

10 Author(s)
Winter, J. A.,
Midgett, M. R.

16 Project Designation

21 Note
Available from: Analytical Quality Control Laboratory
1014 Broadway
Cincinnati, Ohio 45202

22 Citation
June 1969. 33 pp. 9 fig, 2 tab, 7 ref.

23 Descriptors (Starred First)
*Reliability, *Test procedures, *Water analysis, *Chemical analysis, Hydrogen ion concentration, Electrical conductance, Dissolved solids, Hardness (water), Sodium, Potassium, Acidity, Alkalinity, Chlorides, Sulfates, Laboratory tests, Mathematical studies, Statistical methods,

25 Identifiers (Starred First)
*FWQA methods.

27 Abstract

To validate the analytical methods employed by FWPCA, synthetic water samples were prepared in three ranges of concentration for determination of pH, specific conductance, total dissolved solids, and sulfate. The analyses were conducted by 51 analysts from 20 laboratories in FWPCA and five non-FWPCA laboratories. The results of the analyses were treated statistically to determine the accuracy and adequacy of the method employed. Detailed results of the analyses and of the statistical treatments are given in tables and graphs. (Little--Battelle)

Abstractor Robert L. Little

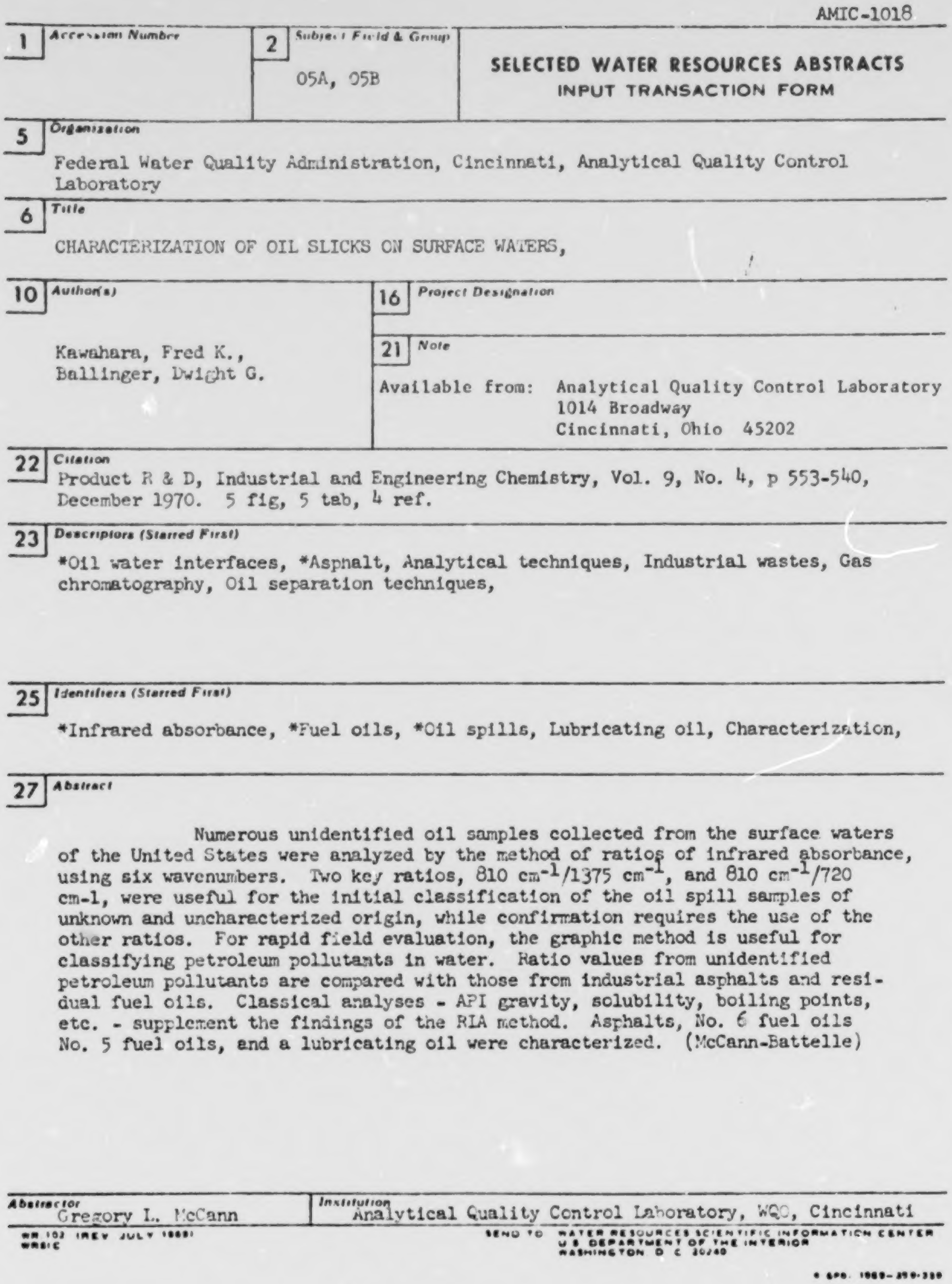
Institution Analytical Quality Control Laboratory, WQO, Cincinnati

WR:102 (REV JULY 1969)
WRSIC

SEND TO: WATER RESOURCES SCIENTIFIC INFORMATION CENTER
U.S. DEPARTMENT OF THE INTERIOR
WASHINGTON, D.C. 20240

* GPO: 1969-359-339

FIGURE 10a. FIRST SAMPLE ABSTRACT PREPARED ON WRSIC FORM



AMIC-1018

1 Accession Number	2 Subject Field & Group 05A, 05B	**SELECTED WATER RESOURCES ABSTRACTS** **INPUT TRANSACTION FORM**

5 Organization

Federal Water Quality Administration, Cincinnati, Analytical Quality Control Laboratory

6 Title

CHARACTERIZATION OF OIL SLICKS ON SURFACE WATERS,

10 Author(s) Kawahara, Fred K., Ballinger, Dwight G.	16 Project Designation 21 Note Available from: Analytical Quality Control Laboratory 1014 Broadway Cincinnati, Ohio 45202

22 Citation

Product R & D, Industrial and Engineering Chemistry, Vol. 9, No. 4, p 553-540, December 1970. 5 fig, 5 tab, 4 ref.

23 Descriptors (Starred First)

*Oil water interfaces, *Asphalt, Analytical techniques, Industrial wastes, Gas chromatography, Oil separation techniques,

25 Identifiers (Starred First)

*Infrared absorbance, *Fuel oils, *Oil spills, Lubricating oil, Characterization,

27 Abstract

Numerous unidentified oil samples collected from the surface waters of the United States were analyzed by the method of ratios of infrared absorbance, using six wavenumbers. Two key ratios, 810 cm^{-1}/1375 cm^{-1}, and 810 cm^{-1}/720 cm-1, were useful for the initial classification of the oil spill samples of unknown and uncharacterized origin, while confirmation requires the use of the other ratios. For rapid field evaluation, the graphic method is useful for classifying petroleum pollutants in water. Ratio values from unidentified petroleum pollutants are compared with those from industrial asphalts and residual fuel oils. Classical analyses - API gravity, solubility, boiling points, etc. - supplement the findings of the RIA method. Asphalts, No. 6 fuel oils No. 5 fuel oils, and a lubricating oil were characterized. (McCann-Battelle)

Abstractor Gregory L. McCann	Institution Analytical Quality Control Laboratory, WQO, Cincinnati

WR 102 (REV JULY 1969)
WRSIC

SEND TO WATER RESOURCES SCIENTIFIC INFORMATION CENTER
U.S. DEPARTMENT OF THE INTERIOR
WASHINGTON D.C. 20240

* GPO: 1969-359-339

FIGURE 10b. SECOND SAMPLE ABSTRACT PREPARED ON WRSIC FORM

TABLE 3. INPUTS TO WRSIC BY TYPE OF PUBLICATION

Type of Document	Number Submitted
Journal Articles	85
Government Research Reports	1
AQCL Reports	10
AQCL Authored Journal Articles and Papers	18
Books	0
Battelle Reports	1
Total	115

On the other hand, the items provided WRSIC do not represent all those potentially of interest. As stated previously, economic constraints almost entirely precluded providing abstracts of reports and books to WRSIC. In addition, time restraints prevented submission of a number of the abstracts prepared during the latter portion of the operational phase of the study. Therefore, to give a better picture of the potential of an Analytical Methodology Information Center, Table 4 shows the number of additional items prepared which could have been provided as WRSIC input had there been no economic or time constraints present.

TABLE 4. ABSTRACTS OF INTEREST TO WRSIC BUT NOT SUBMITTED BECAUSE OF ECONOMIC AND TIME CONSTRAINTS

Type of Document	Number Prepared
Journal Articles	101
Government Research Reports	31
AQCL Authored Journal Articles	5
Books	2
Others	2
Total	141

WRSIC Requirements for Hard Copy. One WRSIC requirement, which is sometimes either difficult or costly to fulfill, is that one hard copy of each item abstracted be transmitted to WRSIC with its abstract form. This can involve considerable expense for a large input. Photocopies of journal articles, utilizing modern photo-reduction methods, cost between 4-1/2 to 25 cents per page (6 cents on the pilot study), depending upon methods and circumstances. Copies of Government research reports procured through the National Technical Information Service are $3.00 each for those less than 300 pages and $6.00 for those larger than 300 pages or more than two years old. Books cost considerably more. Hence the budget to fulfill this requirement may not be inconsequential. On the present project, providing abstracts of Government reports to WRSIC was largely precluded because of budget constraints.

Interface With the Robert A Taft Water Research Center

Interactions with the Taft Research Center have largely been limited to requests for copies of its reports. In every instance, these requests have been honored very cooperatively. In addition, one of the QRI's provided during the study was requested by a member of the technical staff at the Taft Research Center.

It is expected that as work progresses, a logical step will be to provide the same services to the Taft Research Center as are provided for AQCL for requests within the scope of the Analytical Methodology Information Center. It is further conceivable that a compatible remote terminal may reside at that facility so that direct access to the Battelle holdings is available.

As discussed in the section on Loan Services, the library at the Taft Research Center may in the future provide valuable assistance in responding to requests for loan documents, especially from persons outside of AQCL. Further investigation should be made into this possibility.

Interface With the Science Information Exchange (SIE)

The mission of the Science Information Exchange is *"To facilitate effective planning and management of scientific research activities supported by U. S. agencies and institutions by promoting the exchange among participating agencies of information on all types of current basic and applied research . This will include the accumulation, organization, analysis, and maintainence of a comprehensive inventory of current research project summaries, and the making of this information available to the scientific community in a form such that maximum use can be made of this data by the scientist and research administrator."*(Reference 10)

In fulfillment of this mission, over 1,000 research organizations, including Federal agencies, private foundations, universities, state and city governments, industry, and foreign sources cooperate with SIE by providing notifications of on-going research. (It is assumed that EPA notifies SIE of its new research projects.) Contributions from all sources enable SIE to register over 100,000 records annually. Each record is an unpublished summary of who is planning what research, where, and how supported. Since the cumulative record is available to a requester on a fee basis, research which has not been published can be identified and possibly eliminate duplication of effort.

During the pilot study, no occasions arose wherein it was necessary to employ the services of SIE. However, the information center could act as an effective agent for AQCL in soliciting information on current research projects from SIE. For example, identification of related on-going research as well as searching the literature is an important function in evaluating proposed research. Further, with the rapid expansion of research activities related to water quality, state-of-the-art analysis requires communications with fellow researchers. (Reference 11) In these instances, as shown in Figure 11, when a new research project is to be initiated at AQCL, a preliminary effort might consist of notifying AMIC of the interest, requesting not only published applicable information but on-going research as well. The information center, in turn, would request a response by SIE. Either the AQCL investigator or AMIC, if desired, could then contact the identified researchers for further information on the current status of their work and results, if any, which they may have obtained.

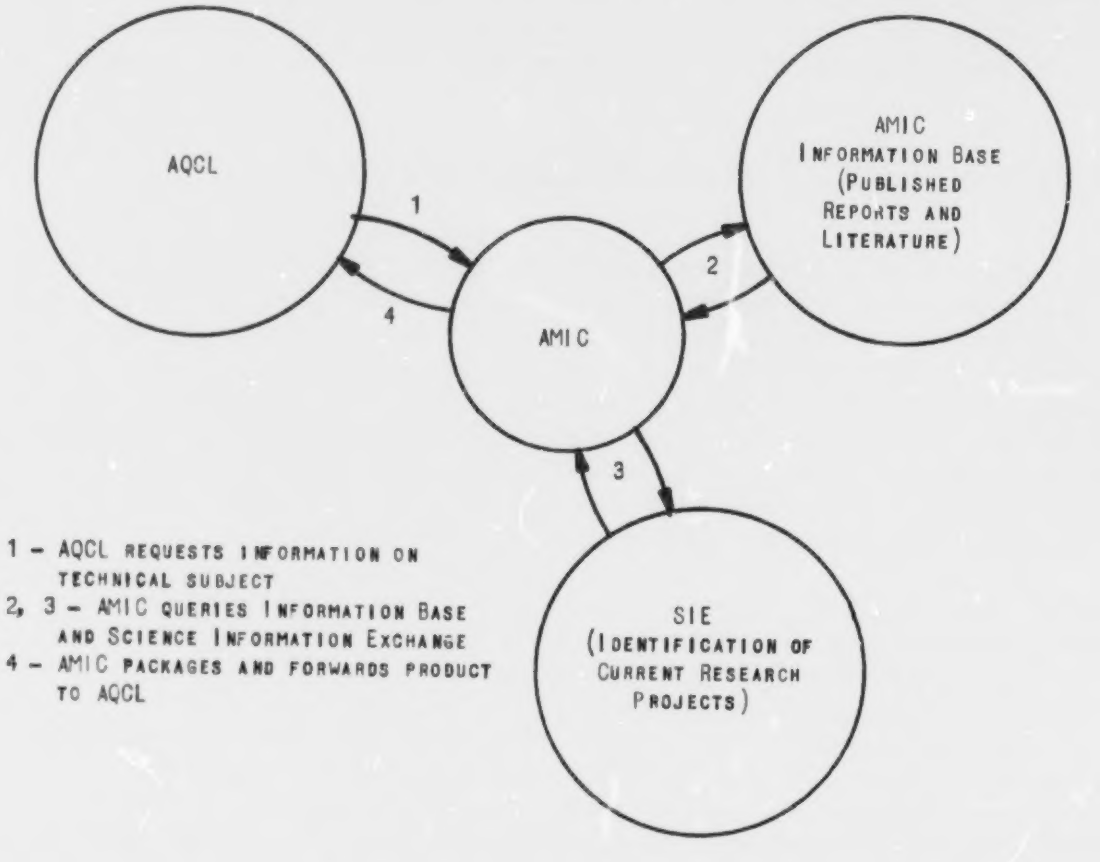

AQCL
AMIC
AMIC Information Base (Published Reports and Literature)
SIE (Identification of Current Research Projects)
1
2
3
4
1 - AQCL requests information on technical subject
2, 3 - AMIC queries Information Base and Science Information Exchange
4 - AMIC packages and forwards product to AQCL

FIGURE 11. POSSIBLE MODE OF INTERACTION BETWEEN AMIC AND SIE

SECTION VIII

INFORMATION SERVICES OF THE ANALYTICAL METHODOLOGY INFORMATION CENTER

An information system has no value unless it provides useful services to its user audience. One of the services the information center should provide for AQCL is the input of abstracted and indexed information to the Water Resources Scientific Information Center. However, other information needs within the EPA community indicate that additional services are desirable. Although services under the present contract were provided primarily for AQCL and the Division of Water Quality Research because of fiscal constraints, it can be stated almost categorically that similar needs exist in other laboratories within EPA.

Information Needs

Experience gained in the operation of other centers at Battelle such as the Arms Control Technical Information and Analysis Center, Defense Metals Information Center, and Radiation Effects Information Center, and during operation of the model information center showed that there are generally needs for:

Assistance in monitoring the current literature (both journals and reports).

Comprehensive reviews of current and archival literature on specific subjects.

Technical assistance in conjunction with literature surveys.

Information on activities in other laboratories: in this instance EPA, state, municipal, or Federal.

Rapid access to archival information.

In an attempt to provide responses to these needs, several services were provided to AQCL and the Division of Water Quality Research. These services were: Quick Response Inquiries (QRI's), a current awareness bulletin, report loan service, an interactive computer system, and a limited translation service. Two services which were not included in the operation of the model center but which are potentially valuable are: Selective Dissemination of Information (SDI), and technical analysis tasks. These are discussed in more detail later in this section of the report.

Quick Response Inquiries

The phrase, "Quick Response Inquiries (QRI's)", is Battelle nomenclature for a service which provides rapid response to urgent requests on wide-ranging subjects. By definition, a QRI is also relatively low cost, depending upon the limits established.

The QRI service can be employed to satisfy many information requirements. It can be used to make comprehensive reviews of current and past literature, provide limited technical assistance, make surveys of current literature outside of the immediate scope of activity, and provide a number of other responses which may be desirable. The results of trials with this service during the pilot program indicate that QRI's provide a much needed service. In addition to information scientists assigned to the center, engineers and scientists in a variety of disciplines as well as expert consultants must be available for technical advice and assistance in answering these QRI's. The technical expertise that can thus be brought to bear on analyzing these problems greatly enhances the utility of the information base.

The usefulness and popularity of this type of service was amply demonstrated during the pilot phase of center operation. Original plans were to establish a limited quick response capability beginning approximately four months after the initiation of the pilot phase. Sufficient funds were set aside for approximately six responses at a projected cost of $500 each. However, urgent requests were received and fulfilled during the first month of operation. By the end of the fourth month, almost all of the projected funds had been used in fulfilling ten separate requests and curtailment of this service was necessary.

A total of 13 quick responses were prepared during the pilot study. Table 5 lists the titles, response times, requester, and responsible staff member for all quick responses. It should be noted that in each case the request called for considerably more than normal reference service. Copies of individual responses are available for review, either through the Project Officer or through the Principal Investigator.

On the present program, the upper limit on the cost of QRI's was arbitrarily set at approximately $500, which would provide up to two man days of professional effort. The total allocation for QRI's was specified as $3,000. However, the total expenditure amounted to $3,720. The average cost per response was about $286. This points up another advantage of the QRI service: the total cost is variable depending upon the amount of effort required. Of the 13 QRI's provided, some cost less than the stipulated $500 maximum whereas others may have slightly exceeded the maximum, although efforts were made to stay close to the stipulated amount.

It should be noted that not all the responses could be termed "quick responses". In some cases, there was no need for quick turnaround. However, in several cases, the response times were indeed quick, ranging from three hours to four days for urgent requests.

TABLE 5. SUMMARY OF QRI'S DURING PILOT OPERATION

QRI	TITLE	REQUESTED BY	DATE REQUESTED	ANSWERED BY	DATE ANSWERED
1	Effect of Copper on Algae and Periphyton	Weber (AQCL)	7/6/70	Little	8/5/70
2	A Search of the Literature for Papers Published by Dr. David Klein of Hope College	Ballinger (AQCL)	7/14/70	Little	7/17/70
3	Availability of Translations of Two German Papers on Analysis of Phosphates in Water	Ballinger (AQCL)	7/14/70	Little	7/29/70
4	Selected References on the Biological Metabolism of Mercury	Swaby (Hdqtrs.)	8/3/70	Lutz/Kohn	8/7/70
5	Possibility of Methylation of Lead and Biological Magnification	Forziati (Hdqtrs.)	8/13/70	Lutz	8/13/70 Telephone Response
6	Status of USDA Report on Disposal of Pesticides	Dean (Taft Center)	9/3/70	Little/Darby	9/9/70
7	Brief Survey of Articles on Water Reuse	Forziati (Hdqtrs.)	9/3/70	Little	9/9/70
8	Extraction of Organophosphorus Pesticides in Water	Lichtenberg (AQCL)	9/23/70	Little	10/21/70
9	Pollution Potential of Fluorine Effluents From Fertilizer Plants	Shackelford (Hdqtrs.)	9/29/70	Little/Darby	9/30/70 Telephone Response
10	Environmental Impact of Detergent Ingredients	Forziati (Hdqtrs.)	10/31/70	Lutz	10/15/70
11	Request for Reference on Optical Brighteners	Forziati (Hdqtrs.)	10/5/70	Little	11/5/70 Telephone Response
12	Cadmium Toxicity	Pickering (Newtown Fish Toxicology Lab)	12/11/70	Little/McCann	1/6/71
12A	Analytical Methods for Cadmium	Kopp (AQCL)	(Not Requested)	Little	1/14/71

The results of the trials with this service indicate that QRI's provide a much needed contribution to EPA's information demands and should be incorporated into a full-scale operation on a rather extensive basis.

Current Awareness

The current awareness service was incorporated into the present program as a means of reducing and hopefully eliminating the amount of time that individual AQCL staff members spend in covering the literature for themselves. If individual coverage of the literature could be eliminated, the scientists' time would be free for more important endeavors, and individual record keeping could be largely eliminated.

Since most of the AQCL staff have in the past been able to cover only a selected portion of the literature pertinent to their interests, their coverage was often incomplete. By assigning this function to an information center, the literature available to the individual staff member can be greatly expanded and because the centralized search will be more efficidnt, will result in cost savings. In anticipation of these potential benefits, the contract to operate a model information center included a provision for three current awareness bulletins to be prepared primarily for the AQCL staff. In preparing the bulletin, which was entitled "Reviews of Current Literature on Analytical Methodology", four important criteria for success were carefully considered: (1) the literature covered must be timely, (2) the amount of coverage must be extensive, (3) the literature cited must fall within the areas of interest to the AQCL staff, and (4) the bulletin itself must not be so imposing as to prevent use. Each issue of the "Reviews of Current Literature on Analytical Methodology" sent to the AQCL staff was accompanied by a form on which each staff member could evaluate the pertinence of each item in his category of interest and make suggestions for improving the publication.

Procedures for Preparing the Current Awareness Bulletin

Based upon the first interviews at AQCL, it was evident that individual staff members at AQCL desired detailed, informative abstracts in the current awareness bulletin, in addition to the bibliographic information. Therefore, the first step after logging each item was abstract preparation and indexing. This required trained information scientists who were familiar with the various aspects of water quality and analytical methodology. The earlier efforts to assure adequate scoping of AQCL's interests (see pages 19 to 23) were of utmost value in assuring that the prepared abstracts indeed represented AQCL interests. Subsequent evaluation and comments by AQCL staff verified that anything else would not have been acceptable. The prepared abstracts were individually typed according to the WRSIC format on a paper-tape typewriter so that punched paper tapes could be used for final typing. The first drafts of the abstracts and citations were then edited, categorized (as described below), and final typed. Final typing consisted of running the prepared paper tapes in the proper sequence and making editing corrections as necessary. At the same time, a corrected tape was prepared from the first one and subsequently used as input to the computerized information system as described beginning with page 34.

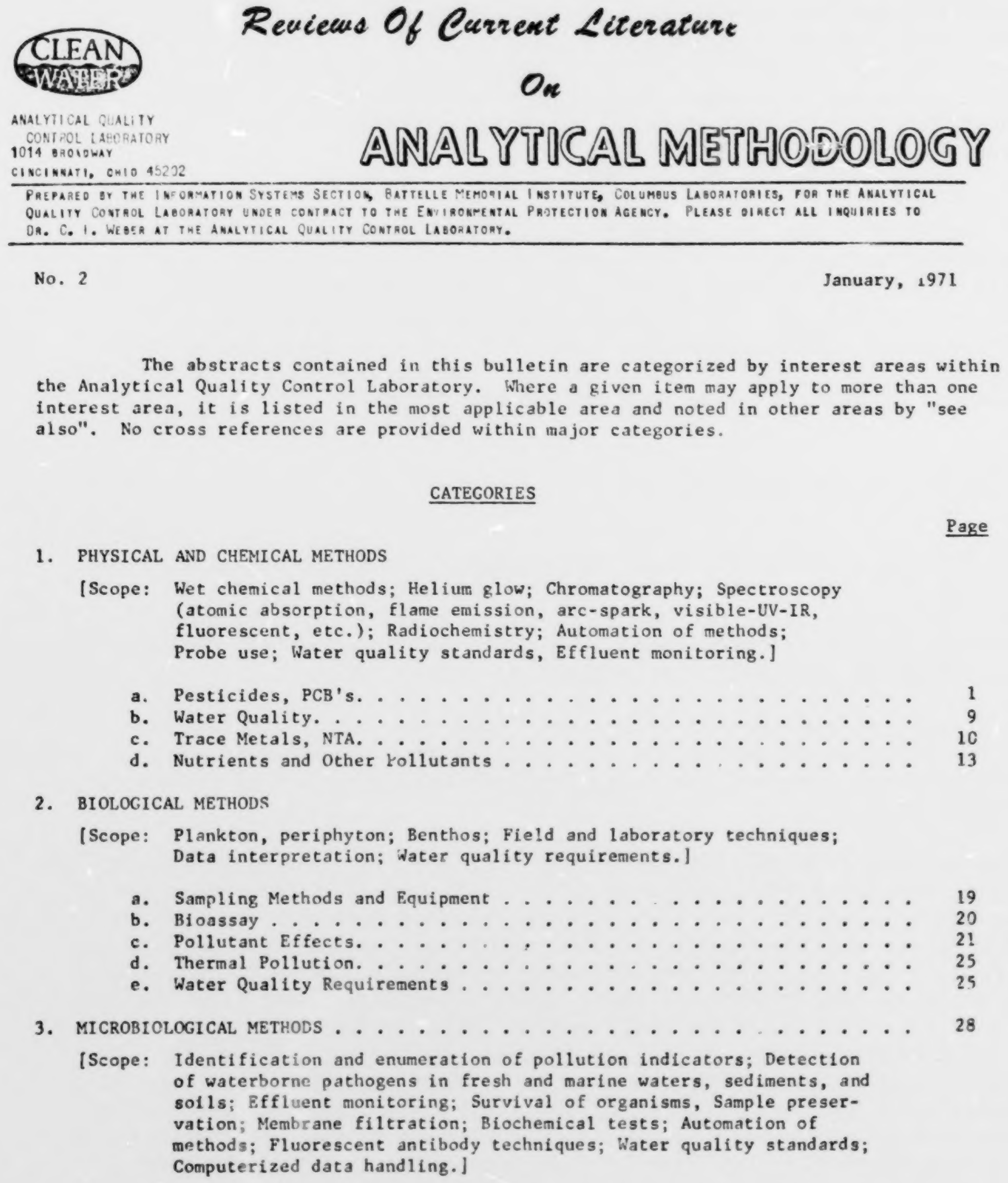
The categories for dividing the abstracts in the "Reviews" were designed to coincide with the activities at AQCL. Within these major categories, several subcategories were defined according to more specific interests within the Groups at AQCL. Critiqués of the draft copy of the first issue by several AQCL staff members provided valuable assistance in defining these subcategories and also in clarifying the scope of each technical Activity. It was felt that the subcategorization would reduce the amount of material that each person had to review.

Description of the "Reviews"

The first issue of the "Reviews" was mailed on December 21, 1970, contained 59 abstracts of technical reports and articles, and was 25 pages long. The second issue was mailed on January 28, 1971, contained 73 abstracts and was 41 pages long. The third issue was mailed on March 5, 1971, contained 162 abstracts, and was 53 pages long.

The increase in the size of the second issue over the first was due not only to inclusion of more items, but also to the increased size of abstracts which were written in a more informative manner as requested by the AQCL staff.

As can be seen from the samples of the "Reviews" reproduced as Figures 12a and 12b, the third issue was a quite radical departure from the second issue not only in size but also in format (the format for the first and second issues was the same). At the request of the Director of AQCL and the Project Officer, the abstracts were printed in a 3" x 5" format on card stock so that individual staff members could clip and file the items of interest. Since various staff members have in the past maintained their own information indexes, this move enabled them to continue maintaining their private files at almost no cost. In fact, assuming that sources of information which were reviewed by the individuals were as well covered by the information center, a significant expense at the Laboratory could be eliminated by the provision of prepared abstracts since the time required for several secretaries to type individual references would be obviated by the "Reviews". In addition, because of extensive coverage during the pilot program, the availability of items to staff members was perhaps in some cases greater than they could expect from their own coverage. It should be mentioned, however, that because of the large volume of material acquired on the pilot study, not all items could be included in the "Reviews". Those judged to be most important and of long-term interest were primary choices. Also, in some instances, items which



CLEAN WATER

ANALYTICAL QUALITY
CONTROL LABORATORY
1014 BROADWAY
CINCINNATI, OHIO 45202

Reviews Of Current Literature On ANALYTICAL METHODOLOGY

PREPARED BY THE INFORMATION SYSTEMS SECTION, BATTELLE MEMORIAL INSTITUTE, COLUMBUS LABORATORIES, FOR THE ANALYTICAL QUALITY CONTROL LABORATORY UNDER CONTRACT TO THE ENVIRONMENTAL PROTECTION AGENCY. PLEASE DIRECT ALL INQUIRIES TO DR. C. I. WEBER AT THE ANALYTICAL QUALITY CONTROL LABORATORY.

No. 2 January, 1971

The abstracts contained in this bulletin are categorized by interest areas within the Analytical Quality Control Laboratory. Where a given item may apply to more than one interest area, it is listed in the most applicable area and noted in other areas by "see also". No cross references are provided within major categories.

CATEGORIES

Page

1. PHYSICAL AND CHEMICAL METHODS

[Scope: Wet chemical methods; Helium glow; Chromatography; Spectroscopy (atomic absorption, flame emission, arc-spark, visible-UV-IR, fluorescent, etc.); Radiochemistry; Automation of methods; Probe use; Water quality standards, Effluent monitoring.]

a. Pesticides, PCB's 1
b. Water Quality 9
c. Trace Metals, NTA 10
d. Nutrients and Other Pollutants 13

2. BIOLOGICAL METHODS

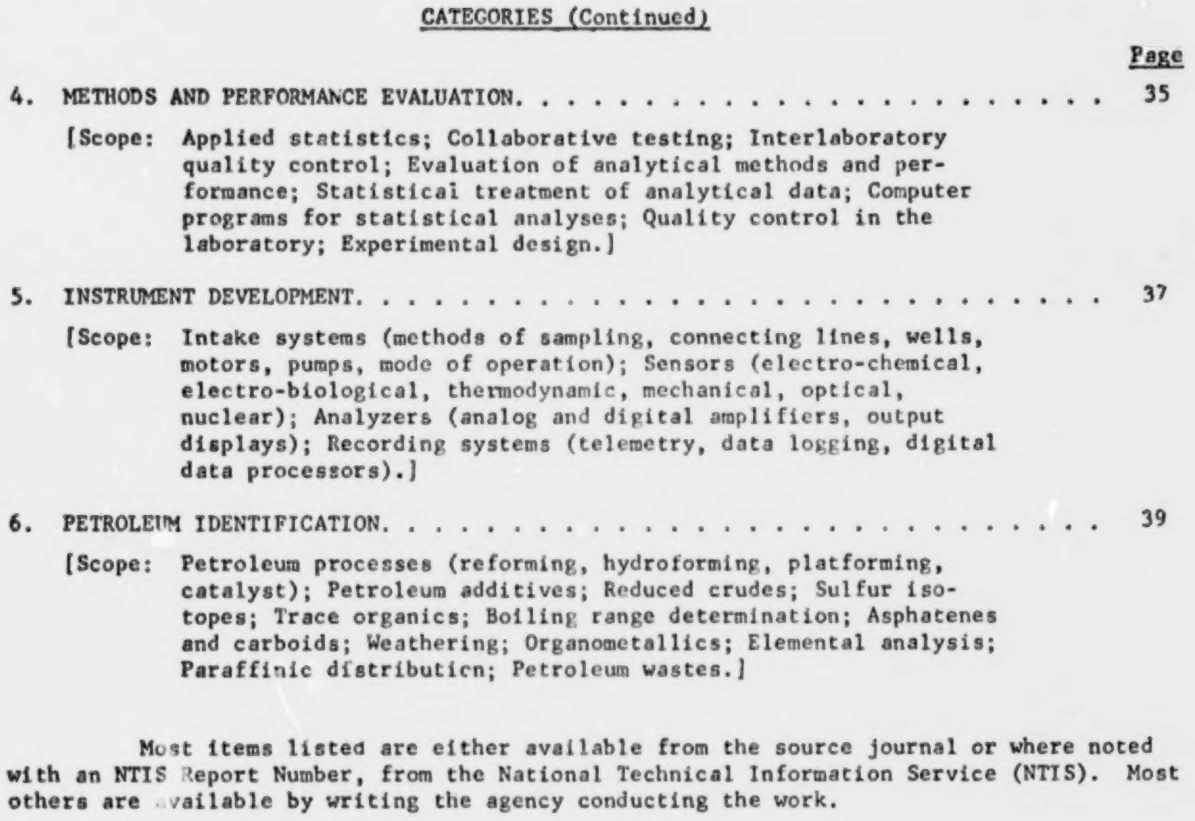
[Scope: Plankton, periphyton; Benthos; Field and laboratory techniques; Data interpretation; Water quality requirements.]

a. Sampling Methods and Equipment 19
b. Bioassay 20
c. Pollutant Effects 21
d. Thermal Pollution 25
e. Water Quality Requirements 25

3. MICROBIOLOGICAL METHODS 28

[Scope: Identification and enumeration of pollution indicators; Detection of waterborne pathogens in fresh and marine waters, sediments, and soils; Effluent monitoring; Survival of organisms, Sample preservation; Membrane filtration; Biochemical tests; Automation of methods; Fluorescent antibody techniques; Water quality standards; Computerized data handling.]

FIGURE 12a. SAMPLE PAGES FROM THE SECOND ISSUE OF THE "REVIEWS"



CATEGORIES (Continued)

Page

4. METHODS AND PERFORMANCE EVALUATION. 35

[Scope: Applied statistics; Collaborative testing; Interlaboratory quality control; Evaluation of analytical methods and performance; Statistical treatment of analytical data; Computer programs for statistical analyses; Quality control in the laboratory; Experimental design.]

5. INSTRUMENT DEVELOPMENT. 37

[Scope: Intake systems (methods of sampling, connecting lines, wells, motors, pumps, mode of operation); Sensors (electro-chemical, electro-biological, thermodynamic, mechanical, optical, nuclear); Analyzers (analog and digital amplifiers, output displays); Recording systems (telemetry, data logging, digital data processors).]

6. PETROLEUM IDENTIFICATION. 39

[Scope: Petroleum processes (reforming, hydroforming, platforming, catalyst); Petroleum additives; Reduced crudes; Sulfur isotopes; Trace organics; Boiling range determination; Asphatenes and carboids; Weathering; Organometallics; Elemental analysis; Paraffinic distribution; Petroleum wastes.]

Most items listed are either available from the source journal or where noted with an NTIS Report Number, from the National Technical Information Service (NTIS). Most others are available by writing the agency conducting the work.

FIGURE 12a. SAMPLE PAGES FROM THE SECOND ISSUE OF THE "REVIEWS" (Continued)

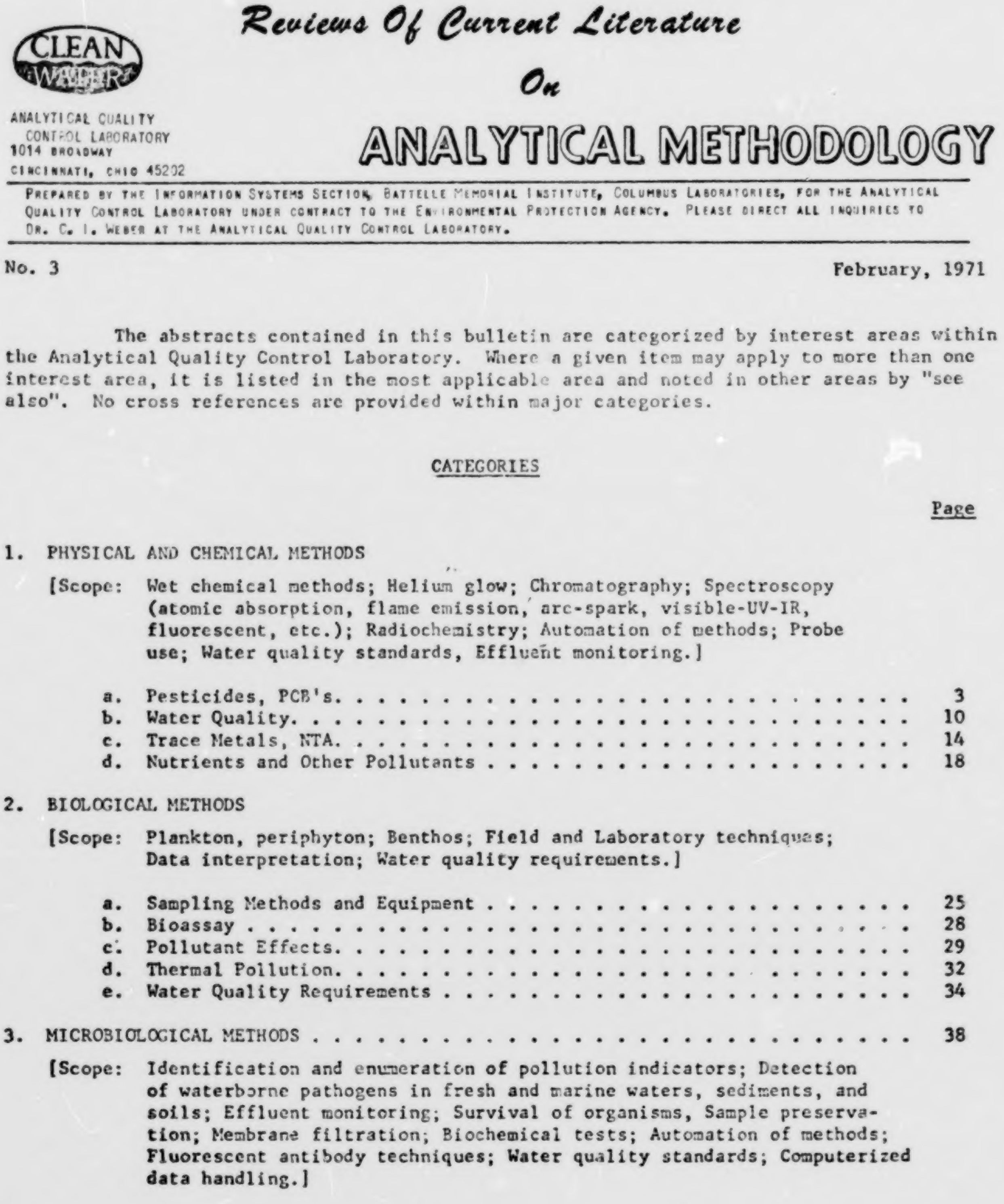
AMIC-746 "A KINETIC METHOD FOR THE DETERMINATION OF FLUORIDE IN THE PARTS-PER-BILLION RANGE", Klockow, D., Ludwig, H., Giraudo, M. A., Analytical Chemistry, Vol. 42, No. 14, December 1970, pp 1682-1686.

Small quantities of fluoride in aqueous solutions can be determined by an indirect kinetic method in which zirconium, acting as a catalyst in the reaction between perborate and iodide, is inhibited by fluoride. In this method, different reaction rates, corresponding to the amounts of fluoride present, are monitored as follows: perborate is present in excess and iodide is added to the mixture by an automatic titrator to the same extent as the reaction proceeds. The rate of addition of the iodide standard solution is a measure for the reaction rate and, consequently, for the concentration of the catalyst (zirconium) or the inhibiting agent (fluoride), respectively. The addition of iodide is controlled by measuring the potential of the iodide/iodine couple. The method has a working range of 19 ng to 190 ng F^- per 50 ml or 0.38 to 3.8 p.p.b. The influence of 20 cations and anions on the determination was examined. Several of these caused serious interference, which suggests that they could be determined by the prescribed method.

AMIC-747 "PYROLYSIS GAS CHROMATOGRAPHIC DETERMINATION OF ARYLSULFONIC ACIDS AND SALTS", Siggia, S., Whitlock, L. R., Analytical Chemistry, Vol. 42, No. 14, December 1970, pp 1719-1724.

This paper describes the quantitative determination of arylsulfonic acids and their salts using pyrolysis gas chromatography to measure either sulfur dioxide or the parent hydrocarbon. Sulfur dioxide is recovered quantitatively; the parent hydrocarbon is recovered at the 50 percent level or less. A linear response for both is obtained for a range of sample weights from 0.2 to 1000 mg. Because of the sensitivity of gas chromatography, it is useful for direct analysis of aqueous solutions down to the parts-per-million concentration of sulfonate. The presence of sodium sulfonate does not interfere. By making sample solutions basic, the interference from sulfuric acid in sulfur dioxide measurement is eliminated. Addition of carbohydrozide to the pyrolysis sample will significantly increase hydrocarbon recovery; for example, the recovery of benzene from benzenesulfonic acid is increased to 98 percent. Best results were obtained when the hydrozide was used alone without added diluent.

FIGURE 12a. SAMPLE PAGES FROM THE SECOND ISSUE OF THE "REVIEWS" (Continued)



Reviews Of Current Literature

On

ANALYTICAL METHODOLOGY

ANALYTICAL QUALITY
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PREPARED BY THE INFORMATION SYSTEMS SECTION, BATTELLE MEMORIAL INSTITUTE, COLUMBUS LABORATORIES, FOR THE ANALYTICAL QUALITY CONTROL LABORATORY UNDER CONTRACT TO THE ENVIRONMENTAL PROTECTION AGENCY. PLEASE DIRECT ALL INQUIRIES TO DR. C. I. WEBER AT THE ANALYTICAL QUALITY CONTROL LABORATORY.

No. 3 February, 1971

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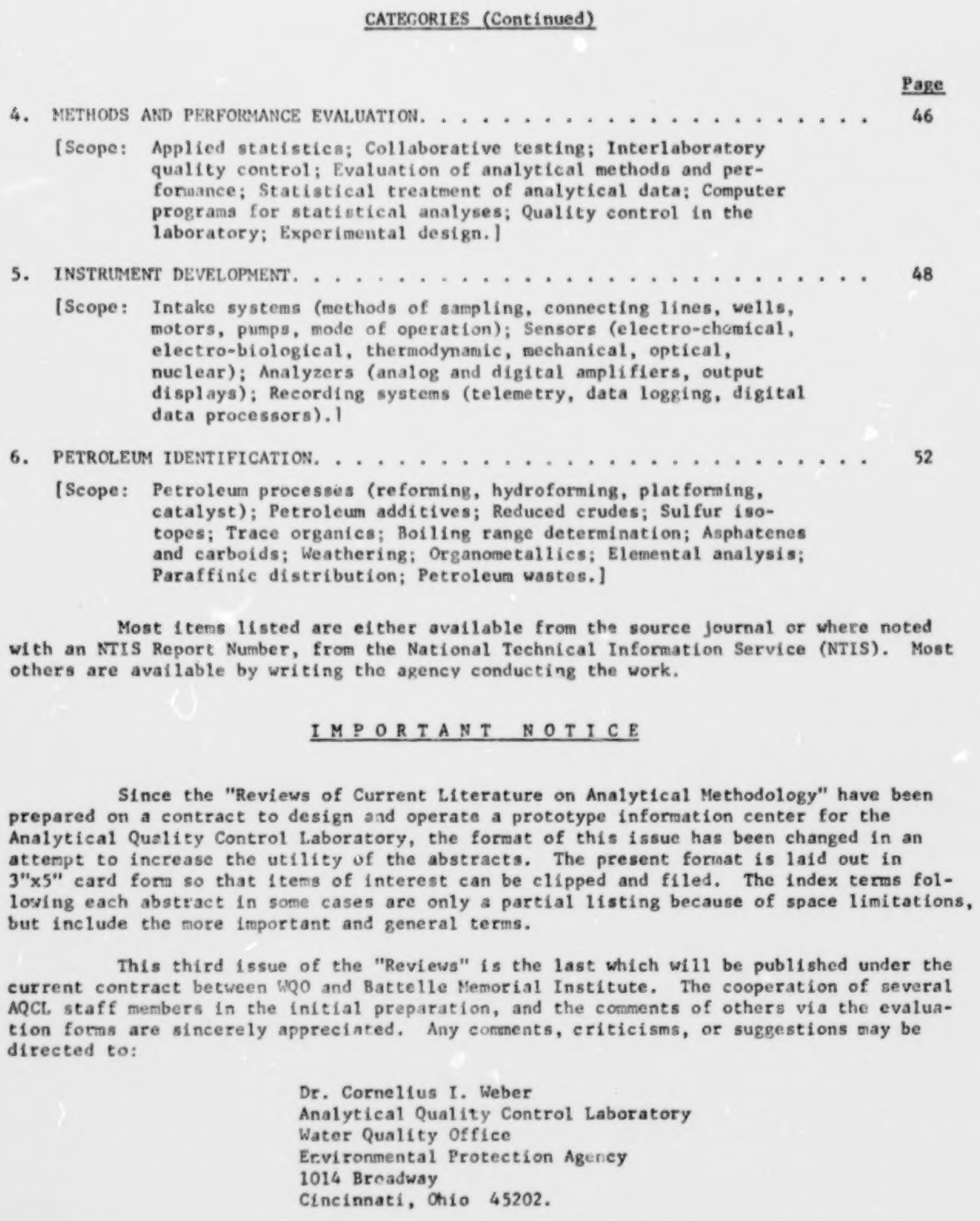
FIGURE 12b. SAMPLE PAGES FROM THE THIRD ISSUE OF THE "REVIEWS"



CATEGORIES (Continued)

Page

4. METHODS AND PERFORMANCE EVALUATION. 46

[Scope: Applied statistics; Collaborative testing; Interlaboratory quality control; Evaluation of analytical methods and performance; Statistical treatment of analytical data; Computer programs for statistical analyses; Quality control in the laboratory; Experimental design.]

5. INSTRUMENT DEVELOPMENT. 48

[Scope: Intake systems (methods of sampling, connecting lines, wells, motors, pumps, mode of operation); Sensors (electro-chemical, electro-biological, thermodynamic, mechanical, optical, nuclear); Analyzers (analog and digital amplifiers, output displays); Recording systems (telemetry, data logging, digital data processors).]

6. PETROLEUM IDENTIFICATION. 52

[Scope: Petroleum processes (reforming, hydroforming, platforming, catalyst); Petroleum additives; Reduced crudes; Sulfur isotopes; Trace organics; Boiling range determination; Asphatenes and carboids; Weathering; Organometallics; Elemental analysis; Paraffinic distribution; Petroleum wastes.]

Most items listed are either available from the source journal or where noted with an NTIS Report Number, from the National Technical Information Service (NTIS). Most others are available by writing the agency conducting the work.

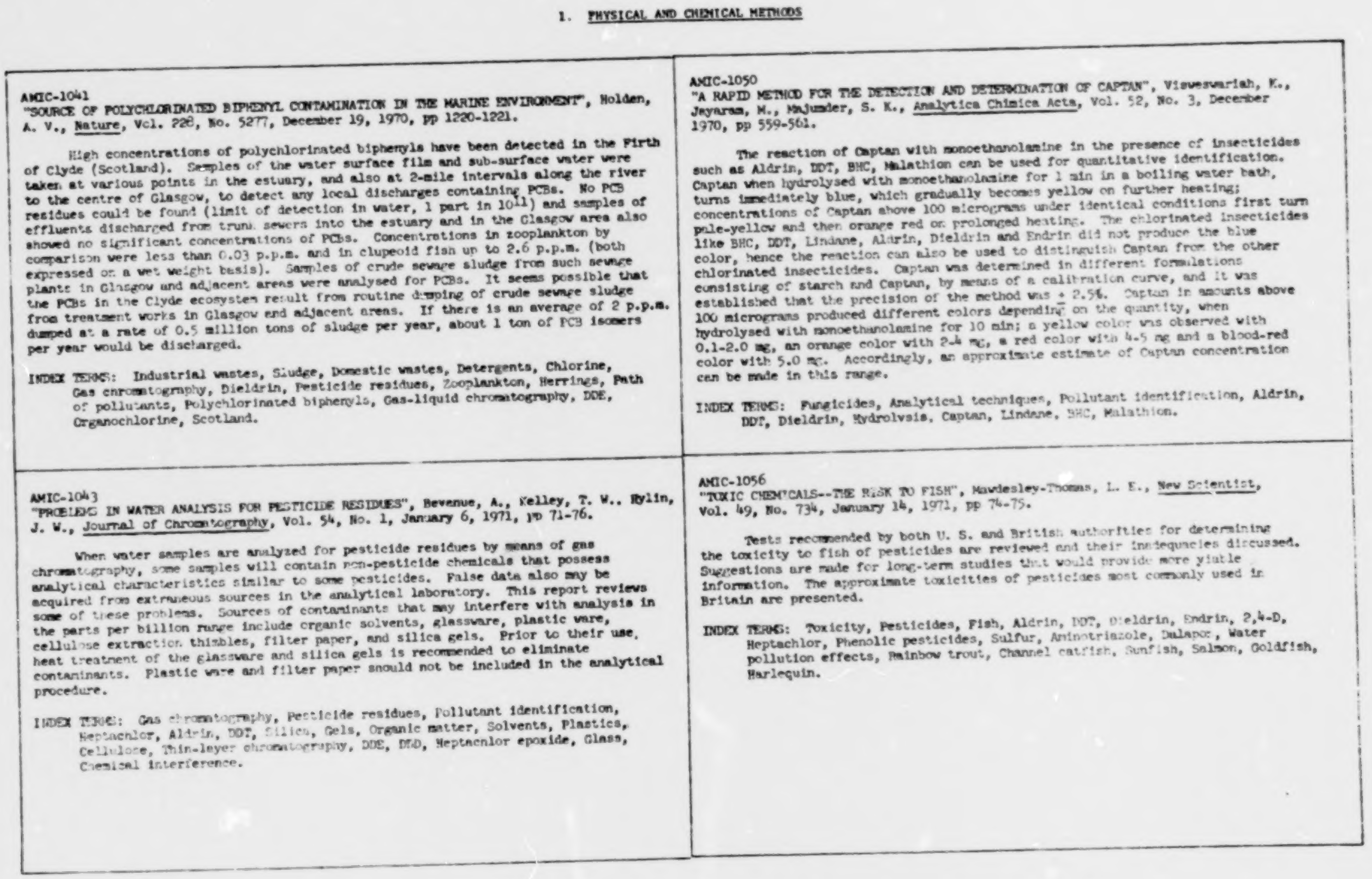
IMPORTANT NOTICE

Since the "Reviews of Current Literature on Analytical Methodology" have been prepared on a contract to design and operate a prototype information center for the Analytical Quality Control Laboratory, the format of this issue has been changed in an attempt to increase the utility of the abstracts. The present format is laid out in 3"x5" card form so that items of interest can be clipped and filed. The index terms following each abstract in some cases are only a partial listing because of space limitations, but include the more important and general terms.

This third issue of the "Reviews" is the last which will be published under the current contract between WQO and Battelle Memorial Institute. The cooperation of several AQCL staff members in the initial preparation, and the comments of others via the evaluation forms are sincerely appreciated. Any comments, criticisms, or suggestions may be directed to:

Dr. Cornelius I. Weber
Analytical Quality Control Laboratory
Water Quality Office
Environmental Protection Agency
1014 Broadway
Cincinnati, Ohio 45202.

FIGURE 12b. SAMPLE PAGES FROM THE THIRD ISSUE OF THE "REVIEWS" (Continued)



1. PHYSICAL AND CHEMICAL METHODS

AMIC-1041
"SOURCE OF POLYCHLORINATED BIPHENYL CONTAMINATION IN THE MARINE ENVIRONMENT", Holden, A. V., Nature, Vol. 228, No. 5277, December 19, 1970, pp 1220-1221.

High concentrations of polychlorinated biphenyls have been detected in the Firth of Clyde (Scotland). Samples of the water surface film and sub-surface water were taken at various points in the estuary, and also at 2-mile intervals along the river to the centre of Glasgow, to detect any local discharges containing PCBs. No PCB residues could be found (limit of detection in water, 1 part in 10^{11}) and samples of effluents discharged from trunk sewers into the estuary and in the Glasgow area also showed no significant concentrations of PCBs. Concentrations in zooplankton by comparison were less than 0.03 p.p.m. and in clupeoid fish up to 2.6 p.p.m. (both expressed on a wet weight basis). Samples of crude sewage sludge from such sewage plants in Glasgow and adjacent areas were analysed for PCBs. It seems possible that the PCBs in the Clyde ecosystem result from routine dumping of crude sewage sludge from treatment works in Glasgow and adjacent areas. If there is an average of 2 p.p.m. dumped at a rate of 0.5 million tons of sludge per year, about 1 ton of PCB isomers per year would be discharged.

INDEX TERMS: Industrial wastes, Sludge, Domestic wastes, Detergents, Chlorine, Gas chromatography, Dieldrin, Pesticide residues, Zooplankton, Herrings, Path of pollutants, Polychlorinated biphenyls, Gas-liquid chromatography, DDE, Organochlorine, Scotland.

AMIC-1043
"PROBLEMS IN WATER ANALYSIS FOR PESTICIDE RESIDUES", Bevenue, A., Kelley, T. W., Hylin, J. W., Journal of Chromatography, Vol. 54, No. 1, January 6, 1971, pp 71-76.

When water samples are analyzed for pesticide residues by means of gas chromatography, some samples will contain non-pesticide chemicals that possess analytical characteristics similar to some pesticides. False data also may be acquired from extraneous sources in the analytical laboratory. This report reviews some of these problems. Sources of contaminants that may interfere with analysis in the parts per billion range include organic solvents, glassware, plastic ware, cellulose extraction thimbles, filter paper, and silica gels. Prior to their use, heat treatment of the glassware and silica gels is recommended to eliminate contaminants. Plastic ware and filter paper should not be included in the analytical procedure.

INDEX TERMS: Gas chromatography, Pesticide residues, Pollutant identification, Heptachlor, Aldrin, DDT, Silica, Gels, Organic matter, Solvents, Plastics, Cellulose, Thin-layer chromatography, DDE, DDD, Heptachlor epoxide, Glass, Chemical interference.

AMIC-1050
"A RAPID METHOD FOR THE DETECTION AND DETERMINATION OF CAPTAN", Visweswariah, K., Jayaram, M., Majumder, S. K., Analytica Chimica Acta, Vol. 52, No. 3, December 1970, pp 559-561.

The reaction of Captan with monoethanolamine in the presence of insecticides such as Aldrin, DDT, BHC, Malathion can be used for quantitative identification. Captan when hydrolysed with monoethanolamine for 1 min in a boiling water bath, turns immediately blue, which gradually becomes yellow on further heating; concentrations of Captan above 100 micrograms under identical conditions first turn pale-yellow and then orange red on prolonged heating. The chlorinated insecticides like BHC, DDT, Lindane, Aldrin, Dieldrin and Endrin did not produce the blue color, hence the reaction can also be used to distinguish Captan from the other chlorinated insecticides. Captan was determined in different formulations consisting of starch and Captan, by means of a calibration curve, and it was established that the precision of the method was ± 2.5%. Captan in amounts above 100 micrograms produced different colors depending on the quantity, when hydrolysed with monoethanolamine for 10 min; a yellow color was observed with 0.1-2.0 mg, an orange color with 2.4 mg, a red color with 4.5 mg and a blood-red color with 5.0 mg. Accordingly, an approximate estimate of Captan concentration can be made in this range.

INDEX TERMS: Fungicides, Analytical techniques, Pollutant identification, Aldrin, DDT, Dieldrin, Hydrolysis, Captan, Lindane, BHC, Malathion.

AMIC-1056
"TOXIC CHEMICALS--THE RISK TO FISH", Mawdesley-Thomas, L. E., New Scientist, Vol. 49, No. 734, January 14, 1971, pp 74-75.

Tests recommended by both U. S. and British authorities for determining the toxicity to fish of pesticides are reviewed and their inadequacies discussed. Suggestions are made for long-term studies that would provide more viable information. The approximate toxicities of pesticides most commonly used in Britain are presented.

INDEX TERMS: Toxicity, Pesticides, Fish, Aldrin, DDT, Dieldrin, Endrin, 2,4-D, Heptachlor, Phenolic pesticides, Sulfur, Aminotriazole, Dalapon, Water pollution effects, Rainbow trout, Channel catfish, Sunfish, Salmon, Goldfish, Harlequin.

FIGURE 12b. SAMPLE PAGES FROM THE THIRD ISSUE OF THE "REVIEWS" (Continued)

the researchers believed to be from sources not regularly reviewed by the AQCL staff were selected as prime items for the "Reviews".

Another modification of the third issue of the "Reviews" was the addition of selected index terms to each reference. Index terms themselves are an accurate and easily reviewed summary of the contents of a particular document. In addition, any person interested in building a personal information system could employ the terms and abstracts as the basic elements of his system with essentially no further intellectual effort required. In the event the AQCL staff has remote terminal access to the information base, individual files may become less important to them.

Evaluation Forms

Evaluation forms were attached to each issue of the "Reviews" going to the AQCL staff to aid the Battelle staff in adjudging their conception of the interests at AQCL. As can be seen in Figures 13a, 13b, and 13c, the first two forms were straight numerical listings of the abstract numbers; the third form was a numeric listing that coincided with the categories of the abstracts in the "Reviews". The important parts of the forms, however, are the gradations of comments permitted the evaluator. By checking one of the boxes for each of the items (in most cases only the items in each person's area of specialty), he could indicate each item as "high interest", "useful", "low interest", or "not of interest". In addition, he could request a copy from the information center or state that he considered the item to be of enough value that he would request a copy elsewhere. The completed forms, when summarized, served two purposes: (1) they indicated the levels of interest in certain technical areas, and (2) they could be used to grade how accurately the Battelle researchers understood the scope of AQCL activities.

As mentioned previously, the evaluation forms, as well as other activities, were used as an aid in establishing the scope of the information center. The scope description in turn was used for guidance in the acquisitions portion of the pilot study.

All (30) of the professional staff at AQCL had an opportunity to participate in the evaluations.

Grading the Pertinence of Items in the "Reviews"

Grading of each of the items in the "Reviews" was based upon several assumptions. First, because of the highly specialized interests of many AQCL staff members, it was assumed that an item that was of "high interest" to one person was more valuable than an item which was rated as "useful" by several others. For the same reason, it was assumed that any one item indicated as being "useful" to one person was of greater value than one

December, 1970

REVIEWS OF CURRENT LITERATURE ON ANALYTICAL METHODOLOGY

SURVEY FORM

This page is designed to assist the Battelle staff in determining the pertinency of the itmes listed in this review to your interests. Please take time to evaluate those items which are listed in your category by checking the boxes which most nearly represent your view. The evaluation codes are:

a. High interest
b. Useful
c. Low interest
d. Not of interest
e. I will request a copy locally
f. Please see that I get a loan copy.

	Evaluation							Evaluation					
Item No.	a	b	c	d	e	f	Item No.	a	b	c	d	e	f
13	4	5	2	3		2	541	1	2	2	4		2
115	1	4	1	3	1		561			4	5		
116	3	4	2	2	2	2	566	1	3	1	5		2
126		1	5	4			567	1	3	5	5		1
154		6	4	3		1	570	3	2		5	1	
204	3	6	2	1			579		8	3	4		
218		2	2	5		1	581	1	2		8	1	2
219	1	2	2	3		1	585	1		3	6	1	1
248	3	3	3	1		2	586	1	2	3	4	1	1
406	2	1	3	6	1	1	589			6	6		
432		1	2	8			590	1	1	4	5		1
438	1	1	6	5			594		4	7	3		1
440	1		2	7	1		597	4	5	1	4	1	2
445	2	2	2	4	2	2	598	3	1	3	4	2	2
446			1	7			599	1	1		9	1	1
447	2	4	4	4	1	2	600	1	1		8	1	1
467			2	4			602	1	4	2	4		3
479	1	2	4	2			604		1	3	6	1	
481	4	3	1	1			607	2	1	2	5		1
489	1	1	2	7	1	1	608	2		2	5		
508	1	1	3	6		2	612		2	5	6		
523	2	2	5	4		2	614	1	6	4	2		
524	2	3	2	4	1	3	620	2	3	2	5		8
527	1	3	3	4	1	2	635			2	8		
528	1	1	6	3	1	1	639	2	2	2	5		2
529		1	5	5	1		641	4	2	3	5		2
532	2	1		6		1	642	6	6		1	1	3
535	2	1	3	4			680		4	6	4		
536			2	9			681	4	4	1	5		
540	1	3	1	6		2							

FIGURE 13a. SUMMARIZED EVALUATION FORM FOR THE FIRST ISSUE OF THE "REVIEWS"

January, 1971

REVIEWS OF CURRENT LITERATURE ON
ANALYTICAL METHODOLOGY
SURVEY FORM

This page is designed to assist the Battelle staff in determining the pertinency of items listed in this review to your interests. Please take time to evaluate those items which are listed in your category by checking the boxes which most nearly represent your view. The evaluation codes are:

a. High interest	d. Not of interest
b. Useful	e. I will request a copy locally
c. Low interest	f. Please see that I get a loan copy.

	Evaluation							Evaluation							Evaluation					
Item No.	a	b	c	d	e	f	Item No.	a	b	c	d	e	f	Item No.	a	b	c	d	e	f
122	1	2	3	6		1	705	2	2	1	2	1	1	745		2	3	10		
128	1	1	3	4		2	706	1	2	5	5		1	746		4	5	5		2
405	5	1	5	4		3	708	1	3	5	4	1		747		1	4	8		
522	1	1	2	5		2	709	4	5	4	2	1	2	750	4			5	1	
632	1		4	7		1	712	2	3	4	4		1	755	2	3		4	1	1
633		3	4	6			715	1	5	4	7			785	1	1	2	3		
638	2	2	2	3		1	718	1	3	3	2	1		786	3	3	5	1		3
646	1	2	2	5	2	1	720	4	7	1	6	2		789	4	1	1	4		1
650		3	1	5	1		723	2	4	3	7	1		791	1	2	1	5		2
653	1	1	3	4		1	724	2	4	2	7	1		792	1		3	4		1
654		3	1	6	2		725	3	3	2	7		1	793	2	3		3	1	
655		1	2	6	1		726		3	5	8			794		2	3	4		1
656		2	2	5	1		727		1	4	10			801		1		6		1
657	1		3	5		1	728	2	1	3	10	1		802	1			6		1
661		6	3	4			729	1	4	4	7			812	2	1	2	3		1
684	4	1	1	4		1	730		2	3	4			829	2	1	5	4		
685	7	4		5	2	1	732		2	4	4			837	1	1	2	6		1
686	1	5		5	1	1	733	4	1	1	5	1		847	1	2		4		1
692		1	3	6	1		735	3	3	2	4	1	2	852	2	2	2	3	1	1
693		2	1	5			737	3	3	4	4	2	2	854		3	1	4		2
694	2	2	1	5		3	738		1	7	4			855	1	1	1	4		2
696	1	1	3	4		1	739	2	4	4	4		1	856	1	1	1	4		2
697		1	1	6			740	1	3	4	6	1	1	857	1	1	1	4		2
698	1	2	1	6		1	741		2	2	3	1		858	1	3	3	7		1
699	1	6	5	3		1	742	1		1	6	1		859	2	3	3	2		1
701	1	4	3	3		1	743	1	1	1	4		2							
703		8	2	5			744	1	1	1	5		1							

FIGURE 13b. SUMMARIZED EVALUATION FORM FOR THE SECOND ISSUE OF THE "REVIEWS"

February, 1971

REVIEWS OF CURRENT LITERATURE ON
ANALYTICAL METHODOLOGY
SURVEY FORM

This page and the attached form are designed to assist the Battelle staff in determining the pertinency of items listed in this review to your interests. Please take time to evaluate those items which are listed in your category by checking the boxes on the attached form which most nearly represent your view. In addition, we would appreciate any comments or suggestions, specifically regarding the 3"x5" card format.

Comments and Suggestions:

Signature

Please return this page and the completed form to:

Battelle Memorial Institute
Columbus Laboratories
Attn: AMIC/Robert Little
505 King Avenue
Columbus, Ohio 43201.

a. High interest
b. Useful
c. Low interest
d. Not of interest
e. I will request a copy locally
f. Please see that I get a loan copy

FIGURE 13c. SUMMARIZED EVALUATION FORM FOR THE THIRD ISSUE OF THE "REVIEWS"

Cat.	Item No.	Evaluation					
		a	b	c	d	e	f
1a	448	3	1	3	4		1
	453	2	1	4	4		1
	575	1	2	4	4		1
	577	2	2	3	4		
	578	2	2	3	4		
	722		4	4	4		
	790	2		3	6		1
	807.	2		2	7		1
	844	2	2	3	5		1
	845	2	3	2	5		
	853		3	3	5		
	871	2	4	1	5		1
	962	1	4	3	5		2
	964	1	1	4	5		1
	1029	2	3	2	5		
	1030		3	2	6		
	1041	3	3	1	5		1
	1043	3	2	4	3		
	1050		3	5	4		
	1056	1	4	1	5		1
	1100	5	7		1	1	
1b	458	2	4	5	2		
	583	1	4	3	4		1
	601		1	5	5		
	616	1	1	1	8		1
	806		4	1	6		
	861	4	4	1	3		2
	891	3	2	4	3		2
	978		3	1	6		
	982	2	1	2	6		1
	1019	3	2	3	4	1	1
	1020	2		1	6	1	1
1c	568	3	2	2	2		1
	821	8	4		1		3
	823	4	3	1	2		2
	824	4	1	3	1		3
	834		4	3	1		
	848	6	2	3	1		2
	902	2	1	6	1		1
	922	1		7	1		
	963	1	1	7	1		
	967		4	4	1		
	970	1	5	2	1		
	1031	8	2		1		2
	1054	3	3	3	1		
	1063	3	3	3	1		2
	1096	3		4	3		
1d	205	6	3	3	1		2
	564	4	1	4	2		1
	670	2	1	3	4		1
	825		1	4	5		
	839		1	3	5		
	843	1	1	4	3		1
	875	1	1	5	3		2
1d (Cont.)	877	1	2	3	4		1
	899	3	1	5	2		
	908			5	4		
	910	4	4	1	2		2
	952	1	1	2	5		1
	956	5	2	1	2		5
	959			4	5		
	968	1	2	2	5		
	996		2	2	6		
	1006		2	3	4		
	1040	4	2	3	1		4
	1051	2		4	4		1
	1052	2	2	3	4		
	1053	1	2	4	4		
	1064		3	3	4		
	1094	2	2	3	4		1
	1097	2	2	3	4		
2a	819	1	1	3	4		
	834	1	1	1	6	1	
	905	3		2	5		2
	907		1	1	7		
	924	2	1	1	5		1
	925	2	1	1	5		1
	961	2	1		6		2
	981	1	1	1	6		1
2b	449	2	3		4	1	2
	866	1		2	6		1
2c	494	2	3	1	3		
	838	1	1	2	5		
	867	2	2	1	5	1	
	879	2	3	1	3		
	890	3		1	5		2
	894	1		3	5		
	898	1	2	1	5		1
	930	2	1	1	6		1
	979	1	3	1	4		
2d	795	1	4		4		1
	870	1	4	1	3		
	886	1	4	1	3		1
	1038		3	2	4		
2e	822	4	2	2	3		
	836	2	1	2	4		1
	865	2	1	2	5		1
	892	2	1	1	5		
	920	1	2	1	5		1
	921	2	1	1	5		2
	969	1	3	1	4		1
	1039	2	2	1	4		2
	1059	4		1	4	1	1
	1084	2	1	1	5		1
3	450			2	7		
	652	1		2	6	1	
	663	3	1		6	1	1
	731	2	1	2	5		2
3 (Cont.)	734	1	1	1	6	1	
	736	3			6	1	
	748	3			6	1	1
	895			1	8		
	913		1	1	7	1	
	914	1	2		6	1	1
	923		1	1	7		1
	926	1	1	2	5		1
	931		2		7		
	971		2	2	5		1
	972	1	2	2	5		1
	973		2	2	5		
	974	3	1		6		2
	975	1	1		7		1
	1042		1		8		
	1044		2	1	7		
	1085		1		8	1	
	1086	3	1	1	5	1	1
	1088	3	1		6	1	
	1089	2			6	1	
	1093	3	1		6	1	1
	1119	2			6		1
4	869	2	1	2	3		1
	939	1	2	2	3		
	951	3	3	1	2		
	1060	4	4	1			
	1071	1	2	1	3		1
	1091	5	3	1			
5	468	6	4	2			3
	587	3	3	3	1		
	711	1	2	2	4		
	809	5	3	2	1		3
	833		1	3	5		
	864	4	4		4		3
	873	2	2	1	4		2
	880	4	2	1	4		2
	941	2	2		5		1
	946	2	2	1	4		2
	1034	2			6		1
	1055	2			6		1
	1080	1	1		6		
	1092	1	1	1	7		1
	1102	1	2		7		1
6	603	2	2	1	3		2
	805	2	1	1	4		
	816	3	1	1	3		1
	872	1	2	1	3		
	896	3	4	1	2		1
	927		3	2	2		
	929		3	1	3		
	1018	3	2	1	3		
	1066	2	1	2	3		
	1070	1	3	2	1		
	1101		2	1	4		

FIGURE 13c. SUMMARIZED EVALUATION FORM FOR THE THIRD ISSUE OF THE "REVIEWS" (Continued)

which had a high frequency of "low interest" indicators. Any item considered to be "high interest", "useful", or "low interest" by the evaluators was considered pertinent to the overall AQCL scope regardless of the number of times it may have been marked "not of interest" since several evaluators marked all items outside their specific area of interest as "not of interest".

Results of Pertinency Evaluations

The evaluation forms from the three issues of the "Reviews" were summarized with the results as shown in Figures 13a, 13b, and 13c. Using the method described in the preceding section, the percentages of items falling in each classification were as shown in Table 6.

TABLE 6. PERCENTAGE OF ITEMS EVALUATED AS "HIGH INTEREST", "USEFUL", "LOW INTEREST", AND "NOT PERTINENT" IN THE THREE ISSUES OF THE "REVIEWS OF CURRENT LITERATURE ON ANALYTICAL METHODOLOGY"

Issue No.	% High Interest	% Useful	% Low Interest	% Not Pertinent	% Items Rated "Useful" Or Higher
1	73	17	10	0	90
2	72	28	0	0	100
3	81	17	2	0	98

The results show a reduction in items considered "low interest" after the first issue of the "Reviews" was published. This reduction, no doubt, resulted from improvement in Battelle's understanding of the AQCL scope. It is not expected that the "low interest" items will be completely eliminated since they are potentially of value and should be included in the information base. The overall conclusion is that the items chosen were well correlated with AQCL's interests.

Distribution of the "Reviews"

Because of the national interest in much of the information included in the "Reviews", copies were circulated to EPA Laboratories other than AQCL.

The final distribution consisted of 29 copies to AQCL staff members and 93 to other EPA offices and laboratories. The final distribution list is included in Appendix G.

Reactions to the "Reviews"

Obviously, the evaluations of the individual items on the evaluation forms indicated a portion of the reactions to the "Reviews". In addition, reactions were noted in personal contacts, comments on the evaluation forms, and letters, both from AQCL and other EPA Laboratories. Some of the reactions were with respect to the current awareness service in general, whereas others were specific to each issue of the "Reviews". Some representative reactions were as follows.

Favorable comments:

> *"This appears to be a service which could be of continuing interest to our Program ..."*

> *"The people in our region are enthusiastic about this publication and find it very useful."*

> *"These abstracts will at least indicate whether we wish more information and thus represent a savings in time."*

> *"The abstracts included for microbiological methods ... are 'zeroing in' on our literature review needs."*

> *"Very good service this time for me!"*

> *"... will become more and more useful for our work."*

> *"The 3" x 5" card format is very useful. There are many I would like to keep in my file, however, I hate to throw the others away ... This particular time I found many other interesting references in areas other than where I normally look."*

> *"I find the new 3 x 5 format equally helpful as compared to the previous format. The classification of items* [on the evaluation forms] *was in identical order to the abstracts. Saves time and is very much appreciated."*

> *"The 3 x 5 card format and index terms are efficient time savers. We plan to duplicate the most pertinent cards for cross-filing purposes."*

> *"'Review' appears to be very current and thorough - some articles I just read in my journals earlier this month."*

> *"Excellent abstracts and coverage."*

> *"Am particularly anxious to obtain copy of AMIC-848, 'Specific Ion Electrodes' ..."*

> *"This listing is an improvement in the area of ion selective sensors and instrumentation..."*

In addition, a number of respondents outside of AQCL requested that their names be placed on the list for regular distribution of the "Reviews" in the future.

Of course, the recipients of the "Reviews" made many helpful suggestions and criticisms. These are summarized below:

> *"More references on entomology and ecology would be helpful."*

> *"I suggest Battelle list all journals searched in each category, so each man knows what was searched and can comment on the depth of search and suggest additional journals."*

> *"I strongly suggest that Arch. f. Hydrobiologie, Int. Revue ges. Hydrobiol., and int. Verein Limnol. be added to the journals reviewed."*

> *"Most references* [in my category this time] *are from the Bull. of Env. Cont. & Tox. and from Anal. Chem.- two journals I routinely review on my own. My interest was higher at first exposure."*

> *"We need abstracts on life histories and taxonomy of insects and other macroinvertebrates."*

> *"Watch for anal. methods for mercury; especially GS methods for organic forms and combustion techniques for solid-type samples."*

> *"Please furnish a list of journals searched in AMIC."*

> *"A few of the analytical procedures such as in Dec. 1970 Analytical Chemistry would be appreciated."*

> *"Page 18 suggests to 'see also' ... I couldn't find them."*

> *"Would it be too much trouble to have* the *check list correspond to* the *order of articles we reviewed?"*

> *"There is still some confusion about the dividing lines between the various activities* [at AQCL]*."*

> *"The response options ...* [on the evaluation forms] *should be reevaluated..."*

> *"Perhaps if the* [3" x 5"] *cards were perforated this would help."*

"In our lab, interest was high with PCB's for 6 months, then NTA for 6 months. Now we have switched to mercury compounds. So for me, my current interest is not being reflected by keywords in my category. Perhaps more frequent updating of keywords is needed. Also, the subgroupings seem to be a handicap to our current integrated research project's..."

"The 3" x 5" cards are fine for filing, but make the "Reviews" overly bulky. I would prefer the format used in the previous reviews."

"The 3" x 5" card would be easier to read if the abstract were shown as two columns..."

"I would like to see the system [(3" x 5" card format)] *applied to wide-coverage publications such as Biological Abstracts and Microbiological Abstracts."*

"Is it necessary for each subject area activity, e.g. Microbiology, to receive all cards from other interest areas?"

"I suggest reducing the coverage, i.e., specifics in the abstracts."

It is quite obvious that the overall reaction to the "Reviews" was overwhelmingly favorable, especially to the third issue which was quite extensive in coverage (162 abstracts) and printed in 3" x 5" format.

Because of the late receipt of many of the evaluation forms, it was not possible to respond, either verbally or in the operations, to most of the suggestions. Indeed, some of the suggestions would have to be clarified before a proper response could be made. However, the comments and criticisms will prove to be valuable as guidelines for establishing an operational program.

Loan Services

One reaction which inevitably results from publication of current awareness bulletins, document listings, bibliographies, and other products of information centers is the question of availability of the technical reports and articles. AQCL has rapid access to the EPA Library at the Taft Water Research Center for many of the items which have been announced to the staff by the Analytical Methodology Information Center. Still, occasions have arisen in which it was expedient for the pilot information center to provide loan services. The number of documents provided to the AQCL staff during the operational portion of the pilot study totalled 360. Of these requests, 286 were provided as retention copies. Most of these were requested via the evaluation forms which accompanied the current awareness bulletin. In addition to the requests received from the AQCL staff, a request from an EPA regional laboratory for 25 documents was received and honored.

The occurrence of these requests, both from within and without AQCL should serve as an alert to the necessity of providing such a service. Investigations should be made into the possibility of arranging for the EPA Library at the Taft Research Center to provide at least part of this service. These arrangements could easily be made by having the information center verify that copies of the items announced in the current awareness bulletin or other publications are available at the EPA Library. Those not available could be provided to the Library by the information center. To ensure that requests would be directed to the proper facility, availability notices could be included in publications issued out of the information center.

Computer System

Since a thorough discussion of the computer system is included within the section entitled INFORMATION SYSTEM, no details will be given here. It will suffice to say that the use of an interactive computer system provides immediate access to the material contained in the information bank. When urgency demands, the total holdings can be searched for pertinent information. As the system enlarges, this capability becomes increasingly valuable since it provides access to more information.

Access to the information bank may be direct by use of a remote terminal or indirect in which case the requester relays his inquiry to a central location where the computer is queried by another person (information scientist).

It is impossible to say that one mode of access is better than the other for every situation. However, there are certain cautions that should be noted concerning direct access. First, those using a direct-access system must be trained to operate the system properly so that his results are satisfactory. Success is more likely if the system is queried by persons who are intimately familiar with the system characteristics. Therefore, providing direct access to the information base should be accompanied by an adequate training program to avoid negative reactions.

Activities at Other Laboratories

Any organization as large as the Environmental Protection Agency must keep its elements informed of the activities at other locations so that duplication of effort can be minimized and more logical approaches to scientific investigations can be provided.

At AQCL, the scientific staff appears to be relatively well informed of the activities at other laboratories throughout EPA. The staff members have identified and are communicating with counterpart staff members engaged in research (Athens, Georgia) projects and special projects (the regional laboratories). As long as personnel remains stable, such communication will continue. However, shifting personnel and increasing research efforts may tend to negate these informal channels of communication. Therefore, establishment of more formal methods of informational interactions between the laboratories needs to be investigated in future operations of an Analytical Methodology Information Center.

Translations

Coverage of the literature related to water analysis and conversations with the AQCL technical staff indicated that much valuable literature is published in foreign countries, often in a foreign language. This information could be a great asset to the total store of information if it were translated. Translations are expensive; however, there are two particular types of assistance that can be provided by an information center. First, an inexpensive search of Technical Translations can be made to determine whether an item has already been translated. If the translation has been done, the expense of getting copies is relatively small. Second, the information center could provide translation of foreign articles. However, indiscriminant translation is too expensive. Any items to be translated must be carefully selected, with the decision to do so approved by the Project Officer. When an article is selected for translation there are various levels of effort that can be selected: translation of captions and paragraph headings may be sufficient; a summary of the article may suffice; or a complete translation may be required. The point is that the information center should have the capability to provide the level of translation to suit the needs of the requester.

During the operation of the model information center, a limited translation service was provided. In one instance, a search was made to determine whether translations were available.

In another instance, a requester was uncertain whether a specific item was pertinent to his interests. In this case, a summary of the article was provided which led him to decide against translation. Had he requested a complete translation, that level of service was also available to him.

Selective Dissemination of Information

Currently, a number of the large information abstractors and indexers, such as Chemical Abstracts Service, Biological Abstracts, and Institute for Scientific Information, are making their products available in the form of machine-searchable magnetic tapes. Since these tapes are too expensive for most users to purchase for their use alone, groups of intermediary services have been formed which purchase these tapes and provide custom searches such as selective dissemination of information (SDI) to subscribers. The SDI service is attractive since it covers an extremely broad sphere of information at relatively low cost to the subscriber. Consequently, the user has access to a large store of information at a fraction of the cost of coverage on an individual basis. This type of service is especially valuable for covering information in fringe or related areas of interest.

Because of the broad interests of the AQCL staff, it is desirable that information in technical areas which impinge on their main interests be covered. During the pilot study, there was high interest in having AMIC explore the potential value of such a service to AQCL. This, however, was not possible within the constraints of the pilot study. It appears desirable to explore the potential value of such a service in conjunction with an operational center. Six interest profiles would be specified according to the interests of each of the Methods Activities at AQCL. The products of the SDI service (which probably would be provided on a monthly basis) would be circulated to various staff members at AQCL who would note items of high interest. These items would be checked by the AMIC staff for duplication and if not present be put into the information base.

Technical Analysis

Many times, agencies such as EPA have a need for state-of-the-art studies, technical compilations, or other support activities in particular areas or subjects for which they may not have the technical capability or manpower available. For example, as this project closed, there was an urgent need at the Southeast Water Laboratory and AQCL for evaluation of mass spectrometers for specific applications. The pilot center was able to provide the vehicle for accomplishing this task. Often the information center can act in a coordinating role to identify qualified persons (including consultants) and make arrangements for the studies to be conducted.

Depending upon degree of interest, subject, time available, and other factors, technical analysis is tailored to meet the requirements of the requester. These studies include a thorough review of the technical literature coupled with technical analysis of the subject. The product of the study is a technical report or compilation which may include recommendations and conclusions when appropriate.

Technical analysis tasks can be an extremely valuable adjunct to the information center activities since they are an intellectual extension of the information base and as such transform the information and data into a more compact and useful form.

SECTION IX

COST ANALYSIS FOR AN OPERATIONAL ANALYTICAL METHODOLOGY INFORMATION CENTER

The final effort in designing a full-scale analytical methodology information center is the calculation of costs. Since cost data are proprietary to Battelle, the detailed breakdown has been submitted to the Project Officer in a separate communication. However, nonsensitive information is included herein. The total costs required for a full-scale center result from:

1. Materials and services purchases
2. Travel costs
3. Personnel salaries
4. Computer use

The staff required to operate the center on a full-time basis would consist of:

Man-Years	Function
0.2	Administrator
1.0	Project leader/information scientist
1.2	Information scientist
0.6	Research engineer
2.2	Clerk/typist
0.02	Washington liaison
0.1	Services support staff

In addition to the core staff, the facility housing the center should have the flexibility to provide part-time help in many areas of expertise as required. For example, while 0.6 man-years of research engineer time is indicated in the above table, the part-time services of engineers and scientists from several disciplines should be available for evaluative or analytical tasks. Likewise, a full-time administrator is not required. Further, the center would not require a dedicated computer. Therefore, it is assumed that computer services will be procured and not directly operated by the center's staff.

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SECTION X

THE FUTURE POTENTIAL OF AN ANALYTICAL METHODOLOGY INFORMATION CENTER

The necessity for developing a comprehensive information/data base for the environmental sciences has been recognized,(Reference 12) but the structure of this base remains to be defined. Various activities and studies have been directed toward a definition of a system that will best meet the needs of the environmental sciences community. For example, the Water Resources Scientific Information Center (WRSIC) is already established under the Office of Water Resources Research, U. S. Department of the Interior; the Water Quality Office of EPA is developing a Technical Information and Management Planning System (TIMPS); and the Environmental Health Service recently completed a study of its information resources (prior to organization of EPA) including means of organizing them into an Environmental Health Information Network.(Reference 13)

Whether environmental information will be housed in a huge, monolithic facility or in a network of highly specialized centers (See Appendix I) remains for future decision making. In the meantime, the urgency of the environmental problem is such that adequate informational services must be established now. The present project was a first step in establishing and operating a system to meet the demands of one portion of the environmental sciences community - that concerned with analytical methodology related to the aquatic environment. The study not only reinforced previous conclusions that information needs are great in this area, but also demonstrated that these needs can be satisfied in a timely manner by the establishment of a properly designed system such as was developed for AQCL.

Throughout the pilot development of the Analytical Methodology Information Center, an overview of the developments in information systems within the total environmental community has been maintained but not allowed to interfere with meeting AQCL requirements. Since the processes and procedures developed for AMIC are compatible with developments within the state of the art of information science, they will likewise be compatible with those employed in any national system which may be developed. Consequently, an Analytical Methodology Information Center is a potential contributor to the national system.

AQCL as the center of competence in analytical methods related to water quality is ideally suited to guide selection and input of information and data in establishing such methodology. By meeting the needs of AQCL and its regional laboratories, AMIC would be in a position to function as part of a national system by providing vital services to that portion of the environmental community concerned with water quality.

To maximize the cost/benefit ratio of an operational AMIC, its potential value as an adjunct to a national system should be thoroughly considered.

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SECTION XI

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SECTION XII

ACKNOWLEDGMENTS

The authors gratefully acknowledge the assistance of the staff of the Analytical Quality Control Laboratory in conducting this study. Special thanks are due Mr. Dwight Ballinger, Laboratory Director and Dr. Cornelius Weber, Chief of the Biological Methods Activity and Project Officer, for their guidance and concern for the success of the study.

Thanks are also extended to the Battelle staff, Messrs. John Mortland and Gregory McCann, Information Scientists, and Mrs. Naomi Cranston, Clerk Typist, who provided valuable assistance in operating the pilot information center.

Robert L. Little
Ralph L. Darby
Bernard K. Dennis

SECTION XIII

APPENDICES

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APPENDIX A

QUOTES TAKEN FROM THE "ANALYTICAL QUALITY CONTROL LABORATORY" PAMPHLET DATED NOVEMBER 1968

"Methods Research

Although analytical methods are available for most of the routine measurements used in water pollution control, there is a continuing need for improvement in sensitivity, precision, accuracy, and speed. Further development is required to take advantage of modern instrumentation in the water laboratory. In microbiology, the use of new bacterial indicators of pollution, including pathogens, creates a need for rapid identification and counting procedures. Biological collection methods need to be standardized to permit efficient interchange of data. the AQC Laboratory devotes its research efforts to the improvement of the routine tools of the trade.

Methods Selection

Assisted by Advisory Committees, the AQCL provides a program for the selection of the available procedures in water and waste analysis. Through the publishing of FWPCA methods manuals, updated regularly, the program insures the uniform application of analytical methods in all laboratories of WQO. The validity of the chosen procedures and the evaluation of satisfactory performance in analysis are verified by reference sample studies involving participation by regional basin and project laboratory staff personnel.

Intralaboratory Quality Control

To maintain a high level of performance in daily activities, every analytical laboratory must provide a system of checks on the accuracy of reported results. While this is part of the basic responsibility of the analyst and his supervisor, the AQCL provides guidance in the development of model programs which can be incorporated into the laboratory routine.

AQC Regional Coordinators

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The Administration-wide quality control program is carried out through WQO Regional AQC Coordinators. The Coordinator, appointed by the Regional Director, implements the program in his regional laboratory and maintains relations with state and interstate pollution control agencies to encourage their use of WQO methods and active participation in the analytical quality control effort. In addition, the Coordinator brings to the attention of the AQC Laboratory the special needs of his region in analytical methodology.

U. S. Geological Survey

Because water quality surveillance is a joint program between WQO, the U. S. Geological Survey, and the states, the AQCL works closely with the USGS in securing uniform methods in both agencies. Through regular interchange of procedural outlines and joint participation in reference sample studies, the two agencies seek to promote complete cooperation in water quality data acquisition.

Professional Liaison

The Laboratory staff, along with other WQO scientists, actively participates in the preparation of *Standard Methods for the Examination of Water and Wastewater* (American Public Health Association), and in subcommittee and task group activities on Committee D-19 of the American Society for Testing and Materials. A senior member of the AQCL staff is General Referee for Water, Subcommittee D, of the Association of Official Analytical Chemists."

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APPENDIX B

COPIES OF MEMORANDA ON THE NATIONAL ANALYTICAL METHODS DEVELOPMENT RESEARCH PROGRAM

UNITED STATES GOVERNMENT
MEMORANDUM

DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

To: See Below

Date: Jan 21, 1970

From: Assistant Commissioner, Research & Development
Assistant Commissioner, Operations

Subject: National Analytical Methods Development Research Program

The Division of Water Quality Research of the Office of Research and Development has been assigned responsibility for the development of analytical methods required by the Administration's national program for water pollution control. The analytical methodology required may be divided into three categories: 1) Research, 2) Standard, and 3) Special.

1. Research Analytical Methodology

This category consists primarily of longer term research generated from within the Office of Research and Development to fill its own needs and the ultimate needs of the Administration. It involves the development of new principles and new applications that, once completed, may or may not be immediately useful to the Operations group without further research. Projects in this category require a very high degree of technical skill and imagination and may involve highly complex and expensive instrumentation. Usually such projects will require two or more man-years for completion. Prime responsibility for research on physical and chemical analytical methodology is assigned to the Southeast Water Laboratory, Athens, Georgia. Responsibility for research on viral and bacterial detection and identification methods, in both fresh and marine waters, is assigned to the Robert A. Taft Water Research Center.

2. Standard Analytical Methodology

Research efforts in this category related to the development of the "tools of the trade" for the Administration and to insuring the reliability of analytical data generated anywhere within FWPCA. The work consists of short-term research requiring less than two man-years for completion and involving the perfection, modification, and

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standardization of methods for the operating programs for FWPCA. The results should have an immediate impact on the collection of water quality data for the Administration's water pollution control program. The complexity of the instrumentation and of the procedures developed should be such that they may be readily applicable to routine surveillance and control operations. Prime responsibility for research on thecmical, biological and microbiological standard analytical methodology, for the establishment of standard analytical methods, and for the assurance of the quality of analytical data generated anywhere within FWPCA is assigned to the Analytical Quality Control Laboratory, 1014 Broadway, Cincinnati, Ohio

3. Special Analytical Methodology

Very short term analytical methodology research requiring less than two man-months of effort comprise the major portion of projects in this category. These projects are usually of the "quick'fix" variety and may be carried out at any laboratory. Also included is all analytical research which is an essential part of a broader research activity such as the elucidation of the mechanism of a reaction, the control of a process, or the explanation of a phenomenon. However, all such work should be carefully examined periodically. When it can be shown that there is a general and continuing need by several groups within FWPCA for the methodology involved, the task should be transferred to one of the two categories described above, as appropriate. Accordingly, all analytical methodology research which requires more than two man-months for completion, should be submitted on "Need" forms to the Assistant Commissioner for Research and Development or to the Assistant Commissioner for Operations before the work is initiated.

Finally, in this category fall all analytical methodology research which for reasons of special technical competence, equipment, or location may best be carried out at a given laboratory regardless of duration or scope. Such work must be approved in each instance by the Assistant Commissioner for Research and Development or the Assistant Commissioner for Operations. Approvals are subject to continual review and relocation to meet program requirements.

The Analytical Quality Control Laboratory will determine deficiencies in present analytical methods, when they are applied to salt water samples, by distributing standard concentrates for analysis by each laboratory after dilution with marine waters representative of the samples usually encountered in the region. Specific task assignments will be made after the results of the cooperative analytical survey have been evaluated.

Only the Analytical Quality Control Laboratory is authorized to issue official FWPCA publications on analytical methods. Other laboratories may publish accounts of their analytical research but may publish methods only with the concurrence of the Analytical Quality Control Laboratory

David G. Stephan

Allan Hirsch

Addressees:

Director, Southeast Water Laboratory
Director, Analytical Quality Control Laboratory
Director, Robert A. Taft Water Research Center
Director, Hudson-Delaware Basins Office
Director, National Water Quality Laboratory
Director, National Marine Water Quality Laboratory
Director, Pacific Northwest Water Laboratory
Director, Robert S. Kerr Water Research Center
Director, Alaska Water Laboratory
Regional Director, Northeast Region
Regional Director, Middle Atlantic Region
Regional Director, Southeast Region
Regional Director, Ohio Basin Region
Regional Director, Great Lakes Region
Regional Director, Missouri Basin Region
Regional Director, South Central Region
Regional Director, Southwest Region
Regional Director, Northwest Region
Director, Water Quality Research
Director, Applied Science and Technology
Director, Process Research and Development

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UNITED STATES GOVERNMENT
MEMORANDUM

DEPARTMENT OF THE INTERIOR
Federal Water Quality Administration

To: See Below

Date: 7 Jul 1970

From: Assistant Commissioner, Research and Development
Assistant Commissioner, Operations

Subject: National Analytical Methods Development Research Program

This memorandum supersedes a memorandum of January 21, 1970, on this same subject.

The Division of Water Quality Research of the Office of Research and Development has been assigned responsibility for the development of analytical methods required by the Administration's national program for water pollution control. The analytical methodology required may be divided into three categories: (1) Research, (2) Standard, and (3) Special.

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This category consists primarily of longer term research generated from within the Office of Research and Development to fill its own needs and the ultimate needs of the Administration. It involves the development of new principles and new applications that, once completed, may or may not be immediately useful to the Operations group without further research. Projects in this category require a very high degree of technical skill and imagination and may involve highly complex and expensive instrumentation. Usually such projects will require two or more man-years for completion. Prime responsibility for research on physical and chemical analytical methodology is assigned to the Southeast Water Laboratory, Athens, Georgia. Responsibility for research on viral and bacterial detection and identification methods, in both fresh and marine waters, is assigned to the Robert A. Taft Water Research Center

2. Standard Analytical Methodology

Research efforts in this category relate to the development of the "tools of the trade" for the Administration and to insuring the reliability of analytical data generated anywhere within FWQA. The work consists of short-term research requiring less than two man-years for completion and involving the perfection, modification, and standardization of methods for the operating programs of FWQA. The results should have an immediate impact on the collection of water

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quality data for the Administration's water pollution control program. The complexity of the instrumentation and of the procedures developed should be such that they may be readily applicable to routine surveillance and control operations. Prime responsibility for research on chemical, biological and microbiological standard analytical methodology, for the establishment of standard analytical methods, and for the assurance of the quality of analytical data generated anywhere within FWQA is assigned to the Analytical Quality Control Laboratory, 1014 Broadway, Cincinnati, Ohio.

3. Special Analytical Methodology

Very short-term analytical methodology research requiring less than two man-months of effort comprise the major portion of projects in this category. These projects are usually of the "quick-fix" variety and may be carried out at any laboratory. Also included is all analytical research which is an essential part of a broader research activity such as the elucidation of the mechanism of a reaction, the control of a process, or the explanation of a phenomenon. However, all such work should be carefully examined periodically. When it can be shown that there is a general and continuing need by several groups within FWQA for the methodology involved, the task should be transferred to one of the two categories described above, as appropriate. Accordingly, all analytical methodology research which requires more than two man-months for completion, should be submitted on "Need" forms to the Assistant Commissioner for Research and Development or to the Assistant Commissioner for Operations before the work is initiated.

Finally, in this category fall all analytical methodology research which for reasons of special technical competence, equipment, or location may best be carried out at a given laboratory regardless of duration or scope. Such work must be approved in each instance by the Assistant Commissioner for Research and Development or the Assistant Commissioner for Operations. Approvals are subject to continual review and relocation to meet program requirements.

The Analytical Quality Control Laboratory will determine deficiencies in present analytical methods, when they are applied to salt water samples, by distributing standard concentrates for analysis by each laboratory after dilution with marine waters representative of the samples usually encountered in the region. Specific task assignments will be made after the results of the cooperative analytical survey have been evaluated.

Only the Analytical Water Quality Control Laboratory is authorized to prescribe official FWQA analytical methods. Official FWQA analytical methods are those that have been reviewed by the Assistant Commissioners

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and approved by the Commissioner. Other laboratories may continue to publish accounts of their analytical research including that pertaining to methods but will not indicate that they constitute official FWQA methods.

David G. Stephan

Eugene T. Jensen

Addressees:

Director, Southeast Water Laboratory
Director, Analytical Quality Control Laboratory
Director, Robert A. Taft Water Research Center
Director, Hudson-Delaware Basins Office
Director, National Water Quality Laboratory
Director, National Marine Water Quality Laboratory
Director, Pacific Northwest Water Laboratory
Director, Robert S. Kerr Water Research Center
Director, Alaska Water Laboratory
Regional Director, Northeast Region
Regional Director, Middle Atlantic Region
Regional Director, Southeast Region
Regional Director, Ohio Basin Region
Regional Director, Great Lakes Region
Regional Director, Missouri Basin Region
Regional Director, South Central Region
Regional Director, Southwest Region
Regional Director, Northwest Region
Director, Water Quality Research
Director, Applied Science and Technology
Director, Process Research and Development

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APPENDIX C

ANALYTICAL QUALITY CONTROL LABORATORY WORK PLANS AS OF JUNE, 1970

BIOLOGY (16030)

1. Development of improved methods to measure total plankton biomass.
2. New methods for the identification of macroinvertebrates.
3. Testing comparability of benthic sampling devices.
4. The effects of exposure period and depth on macroinvertebrate collections from artificial substrates.
5. Artificial substrates for benthic organisms.
6. Mechanical device for sorting bottom samples.
7. Macroinvertebrate biomass as a measure of water quality.
8. Biological identification of the type and level of pollution by using mathematical indices.
9. Methods for automatic phytoplankton counting.
10. Revision of diatom identification manual.
11. Stenonema mayflies in pollution studies.
12. Manual for the identification of Attached Microorganisms (Periphyton).
13. Improved methods for extracting, identifying and quantitating algal pigment.
14. Methods for measuring effects of toxic industrial effluents on natural communities of microorganism.

INSTRUMENTATION (16020)

1. Field investigation of the phenolic measurement system for application in the continuous water quality monitoring instrumentation systems.
2. Expand measurement capability of automatic and continuous water quality monitoring instrumentation systems.
3. Determine feasibility and components required to inferface small digital computer to laboratory instrumentation and regional larger scale digital computer.
4. Network for accumulation and analysis of water quality employing a smaller scale digital computer.
5. Investigation of intake systems for automatic and continuous water quality monitoring instrumentation.
6. Specifications for an integrated water quality data acquisition system.
7. Submersible water quality measurement system.
8. Measurement of flow through automatic water quality monitors.
9. Development of new flow cell concept for application in automatic water quality monitoring instrumentation systems.

MICROBIOLOGY (16030)

1. Investigation of improved methods for the identification of enteric pathogens.
2. Rapid identification and enumeration of microorganisms in water by the fluorescent antibody technique.
3. Effect of storage time and temperature on water samples for microbiological analyses.
4. Methods for determining the survival of pathogens and indicator organisms.
5. Development of a delayed incubation membrane filter test for fecal coliforms.
6. Development of improved methods for the detection of fecal streptococci.
7. Development of a method for the microbiological analysis of sediments and water-mud interfaces.
8. The development of a method for the isolation and enumeration of enteropathogenic E. coli from water.
9. Methods for the isolation and identification of leptospira in water.

PHYSICAL & CHEMICAL (General Analyses) (16020)

1. Evaluation of methods for measuring nitrilotriacetic acid.
2. Continuous monitoring by automated colorimetric procedures.
3. Evaluation of mercury chloride interference in nutrient analyses.
4. Evaluation, modification, and development of automated colorimetric laboratory procedures.
5. Determination of total phosphorus in organic samples.
6. Evaluation of specific ion electrodes.

PHYSICAL & CHEMICAL (Metals) (16020)

1. The quantitative determination of trace metal ions using the helium glow technique.
2. Application of fluorescence to metals analysis.
3. Better methods for metals determination from remote areas to avoid sample shipment - ion exchange.
4. Improved methods for the characterization of oil based on metal content.
5. Sample preservation and prolonged storage.
6. Determination of selenium in surface water by atomic absorption spectroscopy.
7. Efficiency of extraction and separation methods for trace metals by absorption and/or emission spectroscopy.
8. A computer program for trace metal calculations.
9. FWPCA official methods for trace metals by atomic absorption spectrophotometry.

PHYSICAL & CHEMICAL (Oil Pollutants) (16020)

1. Characterization and identification of light oils and heavy fuel oils by means of differential thermal analyses.

2. Identification of crude oils by the thin layer chromatographic analyses of the pentafluorobenzyl derivatives of phenols, mercaptans, and acids in crudes.
3. Development of methodology for rapid analyses of physical mixtures of oil slicks.
4. Identification of crude oils spilled in surface waters by gas chromatography.
5. Characterizing and identification of heavy fuel oils and other petroleum products by molecular photochemical spectroscopy.
6. Identifying certain oil slicks through analyses for vanadium and nickel.
7. Toxic wastes solvated by waste petroleum products.

PHYSICAL & CHEMICAL (Organics) (16020)

1. Method for isolation and identification of polychlorinated biphenyl compounds in water.
2. Method for evaluating the qualitative accuracy of analytical procedures used for determination of organics in water.
3. FWPCA method for organophosphorus pesticides in water.
4. Method for determination of specific organic nitrogen compounds in water.
5. FWPCA method for organochlorine pesticides in water.
6. An internal control compound to validate results of analysis of surface waters for chlorinated pesticides.
7. Efficiency of carbon adsorption method for recovery of specific organic compounds from water.
8. Liquid chromatography as a tool for clean-up, separation and identification of organic pollutants.

METHODS & PERFORMANCE EVALUATION (16020, 16030)

1. Evaluation of analytical methods selected by FWQA for nutrient analyses.
2. Evaluation of analytical methods selected by FWQA for demand analyses.
3. Evaluation of analytical methods selected by FWQA for plankton, biology.
4. Evaluation of automated methods of analyses selected by FWQA for minerals and nutrients.
5. Evaluation of ASTM and FWQA method of analyses selected for chlorinated hydrocarbon pesticides.
6. Development of Nitrilotriacetic Acid (NTA) reference samples for intralaboratory quality control in FWQA.
7. Development of trace metal reference samples for intralaboratory quality control in FWQA.
8. Development of mercury reference samples for intralaboratory quality control in FWQA.
9. Development of mineral reference samples for intralaboratory quality control in FWQA.
10. Development of nutrient reference samples for intralaboratory quality control in FWQA.
11. Development of demand reference samples for intralaboratory quality control in FWQA.

APPENDIX D

JOURNALS AND ABSTRACTS REVIEWED DURING THE PILOT STUDY

Journals

	Expected Items/Year
ASME Journal of Basic Engineering	1
Agricultural Chemicals	2
Agricultural Research	12
American Midland Naturalist	15
American Oil Chemist's Society Journal	8
American Society of Civil Engineers' Journal of the Sanitary Engineering Division	15
American Society of Civil Engineers' Journal of Irrigation	2
American Society of Civil Engineers' Journal of Hydraulics	6
American Water Works Association Journal	33
Analyst	31
Analytica Chimica Acta	28
Analytical Biochemistry	6
Analytical Chemistry	24
Applied Microbiology	88
Applied Spectroscopy	4
Archives of Environmental Health	5
Association of Official Analytical Chemists' Journal	18
Bacteriological Reviews	1
Bioscience	8
Bulletin of Environmental Contamination and Toxicology	20
Bulletin of Marine Science	10
CRC - Critical Reviews in Environmental Control	6

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	Expected Items/Year
Canadian Journal of Microbiology	12
Canadian Fisheries Research Board Journal	60
Chemical and Engineering News	45
Chemical Engineering	14
Chemical Processing	1
Chemical Week	25
Commercial Fisheries Review	6
Control and Instrumentation	8
Control Engineering	6
Ecology	14
E E E	3
Electrochemical Society Journal	3
Electrochimica Acta	1
Electronic Instrument Digest	7
Environment	12
Environmental Science and Technology	40
Health Laboratory Science	2
Hydraulics and Pneumatics	1
Hydrocarbon Processing	3
IEEE Transactions on Industrial Electronics and Control Instrumentation	2
ISA Transactions	6
Indian Academy of Science, Proceedings	6
Indian Institute of Science, Journal	1
Indian Journal of Technology	2
Industrial Research	6
Industrial Water Engineering	26

	Expected Items/Year
Institute of Petroleum, Journal	6
Instruments and Control Systems	12
Instrument Practice	2
Instrumentation	4
Instrumentation Technology	6
International Association of Science Hydrology, Bulletin	2
International Journal of Applied Radiation and Isotopes	4
Journal of Agriculture and Food Chemistry	8
Journal of Applied Bacteriology	6
Journal of Bacteriology	1
Journal of Chromatography	16
Journal of Chromatographic Sciences	5
Journal of General Microbiology	5
Journal of Marine Research	1
Journal of Physical Chemistry	2
Journal of the Science of Food and Agriculture	4
Journal of Microscopy	2
Laboratory Practice	6
Limnology and Oceanography	88
Limnos	3
Mikrobiologiya	12
Microchemical Journal	5
Microscope	1
Mikrochimica Acta	7

	Expected Items/Year
Mycologia	3
Mycopathologiaet	2
National Academy of Sciences, Proceedings	1
Nature	12
New York Academy of Sciences, Transactions	4
New Scientist	24
New Zealand Journal of Agricultural Research	2
Ocean Engineering	2
Ocean Industry	4
Oceanology International	3
Ohio Journal of Science	8
Okeanologiya	12
Pesticides Monitoring Journal	10
Plant and Soil Science	2
Product R & D, Industrial and Engineering Chemistry	7
Public Works	6
Quality Progress	4
Royal Society of London, Biological, Philosophical Transactions	1
Research/Development	3
Review of Scientific Instruments	2
Science	66
Sea Frontiers	1
The Sciences	2
Technometrics	1
Water and Sewage Works	24
Water and Wastes Engineering	11

	Expected Items/Year
Water and Water Engineering	3
Water Pollution Control Federation Journal	68
Water Research	35
Water Resources Bulletin	6
Water Resources Research	8
World Petroleum	1
Zeit für Analytische Chemie	5
Total	1,206

Abstract Sources

Dissertation Abstracts

Engineering Index

Gaylor's Technical Survey

Monthly Catalog of U.S. Government Publications

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International Journal of Air and Water Pollution

Internationale Revue des Gesamten Hydrobiologie

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Journal of Quality Technology

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APPENDIX F

UNITED STATES
DEPARTMENT OF THE INTERIOR
WATER RESOURCES SCIENTIFIC INFORMATION CENTER

Guidelines and Instructions for Abstracting and Indexing Scientific and Technical Documents for the Water Resources Scientific Information Center (WRSIC)

Revised
December, 1969

UNITED STATES
DEPARTMENT OF THE INTERIOR
WATER RESOURCES SCIENTIFIC INFORMATION CENTER

These instructions have been prepared for the use of those who are providing scientific and technical documents to the Water Resources Scientific Information Center. With the publication growth in all fields within recent history, information centers have undertaken the task of keeping the various scientific communities aware of current and past developments. An abstract and carefully selected index terms taken together offer the user of WRSIC services a rapid means of deciding whether a document is pertinent to his needs and professional interests, thus saving him the time necessary to scan the complete work. These also provide WRSIC with a document representation which is more easily stored and manipulated to produce various services.

Authors are requested to accept the responsibility for preparing abstracts of their own papers in the interest of facilitating quick evaluation, announcement, and dissemination to the scientific community. Abstracts in consistent format must also be generated for those foreign and domestic materials not previously abstracted. We ask that you follow the guidelines set forth below for abstracting and indexing documents prepared in your professional field whether the document was written by you or your colleagues.

A. ABSTRACTING

1. Definition

An abstract of a document is a shortened version containing or referring to essential parts of the original. Other terms more or less synonymous are extract, synopsis, summary, digest, and condensation. Because of its abbreviated content, an abstract cannot contain all the information given in the complete document; however, it can provide the reader with useful information and with a means of determining whether the complete document should be obtained for study. From the author's viewpoint, he should strive to be sufficiently descriptive as to cover the most significant points; from the reader's viewpoint the abstract should be representative of the contents to the extent that reading it will enable a quick decision as to pertinency.

2. Kinds of Abstracts

Two kinds of abstracts are used in the WRSIC system: informative and indicative. An informative abstract is one that contains the essential facts reported in a document, including conclusions or recommendations. It may satisfy the information needs of the reader without his having to see the complete document. An indicative or descriptive abstract tells the reader about the general content of the document. This type should also be explicit enough to enable evaluating pertinency, but it usually cannot be regarded as a substitute for the full document.

The informative abstract probably does not require much more time to prepare than the indicative type; it is, therefore, preferred for use by WRSIC and should be prepared whenever possible. Some documents, however, are so long and detailed that abstract space limitations will make the indicative type more appropriate. There are occasions when a combined informative-indicative type would be quite appropriate.

Appendix A gives examples of the indicative, informative, and combined abstracts.

3. Abstract Content and Format

Rigid standardization of the abstract and its content is neither necessary nor desirable. Both content and order of presentation will depend on the type of document being abstracted and type of abstract to be written. Some guides for abstracting are:

Use complete sentences.
Avoid repeating the title in the first sentence.
Use language from the document whenever possible.
*Tell what is new.
*State the problem investigated.
*Give the method of investigation used.
*Report the conclusions.
*Give important results justifying the conclusions.
*Indicate whether important tables or graphs are included.

When you are abstracting another investigator's work, another important guide is not to editorialize; an abstract should never reflect your

---

*Applicable primarily to informative-type abstract.

opinion as to the quality of work performed or validity of conclusions drawn nor should it include any material or comments not in the original document.

The abstract may start with a statement as to what new method, result, or theory is reported, or it may begin with the purpose of the study and set the stage for results and conclusions. Other abstracts may start with conclusions. In any case, the reader should experience a smooth flow of thought from one part to the next. If the document includes a good bibliography of 15 or more references, this should be stated in the abstract. For example: This article contains 26 references.

If an author abstract is available, the contents may be used as a guide to preparation of the WRSIC abstract.

Additional information on writing abstracts may be found in the selected bibliography to these instructions.

4. Tense and Voice

An abstract may be written in either the present or past tense. However, since many abstracts report the result of research or experiments, they should be written in the past tense. Some portions, such as conclusions that are independent of time, may be written in the present tense. The active voice is preferred.

B. INDEXING

1. Purpose of Indexing

Indexing a document in depth accomplishes two objectives: (1) it provides multiple access to the document from many subject-matter points or concepts, and (2) it allows for flexibility in coordinating several terms describing the user's subject interest profile in a Selective Dissemination of Information (SDI) program.

2. Definitions

Indexing is the selection of specific words or terms which describe the content of a document. Such words are called descriptors, identifiers, or keywords. As used by the Water Resources Scientific Information Center, a *descriptor* is a word or combination of words preselected for inclusion in a thesaurus.

Identifiers are other terms not found in the approved thesaurus but needed for the complete indexing of a document. Identifiers may include geographical names, trade names, names of persons, names of procedures or processes, producers, or terms similar to those in the thesaurus.

3. Thesaurus

The Water Resources Scientific Information Center requires the use of the Water Resources Thesaurus, available from the U.S. Government Printing Office, Washington, D.C., for $2 a copy. (Upon request to WRSIC, a few copies of the thesaurus are available for review.) It is a listing of terms selected to represent all facets of the water-resources field. Broader and narrower terms are given in hierarchical schemes. For easier indexing, related terms are given to suggest to the indexer other descriptors that may be applicable to the document being indexed. Other terms not listed in the thesaurus as descriptors may be found with a "use" reference indicating a substitute approved term.

4. Procedure

Representative terms that cover the concepts discussed should be listed and compared with those available in the thesaurus. If a term appears on your list and in the thesaurus it is listed as a descriptor. If not, it is listed as an identifier.

There is no fixed number of descriptors which adequately describes a document. Between 10 and 20 descriptors are customarily used to index the average report of 25 pages, since the greater the depth of indexing, the greater the chance of retrieving only relevant documents in a computer-aided search.

5. Weighting Descriptors

All descriptors used in indexing a document are not of equal importance in representing the contents. Ideally, each descriptor should be weighted in accordance with a scale of relevance. As a practical approach, the WRSIC system provides for the use of asterisks, but when 20 descriptors have been selected 4 or 5 may be an appropriate number to be shown with asterisks. However, the use of the asterisk for a broad term, such as biology, water pollution, hydrology, or economics is rarely justifiable.

The most important use of the starred descriptors and identifiers is in the printed subject indexes. Since a machine-produced subject index would list the title of a document under as many descriptors and identifiers as were used to index that document, the economy of printing space and machine time dictates that only a portion of the total descriptors and identifiers be used. Hence the importance of singling out the few most significant terms by the use of asterisks.

6. Selecting Identifiers

The Water Resources Thesaurus was compiled to include as many terms as were thought to represent that field at the time. One should recognize inadvertent omissions are impossible to avoid and that new terms are being coined constantly, thereby working toward incompleteness. Thus, useful indexing terms not included in the thesaurus may be needed and should be listed as identifiers.

C. REVIEW AND STANDARD FORMAT

1. Review of Author-Abstracts and Indexing Terms

Each author-generated abstract and indexing terms, whether incorporated in the original document or prepared especially for WRSIC on the WR-102 input transaction form, should conform to the WRSIC requirements as closely as possible. When necessary a limited review and revision will be made by WRSIC and input transaction forms requiring substantial revision will be returned to the source.

Ordinarily only one abstract per document will be required. In some cases, however, such as proceedings or transactions of conferences, anthologies, and certain other types of compilations in which essentially separate papers or documents are issued as a single physical entity, the abstractor may feel that more than one abstract should be prepared. In this case, the abstractor should check with WRSIC so that coordination with other WRSIC abstracting sources may be made to avoid duplication and gaps. Where more than one abstract per physical entity is prepared, a general abstract and citation covering the item as a whole must also be prepared.

2. Review of Nonauthor Abstracts and Indexing Terms

Abstracts and indexing terms prepared for WRSIC should conform to the requirements for WRSIC operations. WRSIC Input Transaction Form WR-102 (rev. July 1969), should be used for all submissions to WRSIC. Each form must be accompanied with an original of the document abstracted. Nonmonographic documents, such as articles in technical journals, should be either extracted from the parent publication or reproduced in full size. Sufficient bibliographic information to identify the parent publication or source should be placed on the front of the document. Form WR-102 will be furnished by WRSIC upon request.

3. Standard Format

To ensure usability of the completed Input Transaction Form for machine-input, adherence is required to the following specific instructions which are keyed to numbered fields of the WRSIC Input-Transaction Form (WR-102).

The specific rules for completing the form should be thoroughly understood and carefully followed. The WRSIC information-retrieval system requires that the individual user of Selected Water Resources Abstracts has sufficient information within the abstract to determine whether or not he wants to obtain the document. He must also have sufficient bibliographic information to obtain the document either from a document collection, such as a library or information center, or from the issuing source. Finally, descriptors and identifiers must be carefully chosen to insure that the most important information concepts in the document are identified for the user.

Exhibits A through E are examples of entries for a journal article, a book, a technical report, a conference proceedings, and a translation of an article, or report.

Specific Instructions for Completing WRSIC Input-Transaction Form

Entry: (1) Accession Number. Leave this space blank. This number will be assigned as the WRSIC identification number for Selected Water Resources Abstracts.

(2) Subject Fields & Groups. Select from Classification Scheme for the Water Resources Scientific Information Center, August, 1968, included as a separate document, the appropriate field and group to describe the document in hand. Place a zero in front of the field and group. If a secondary field and group is considered necessary, place a comma after the first field and group, and enter the secondary subject category, e.g., 05B, 06E for an abstract on the legal aspects of sources of pollution.

(5) Organization. Name of organization performing the work, i.e., corporate author or author's affiliation. The essential elements of the corporate author entry are: significant organization elements for source identification and geographic location, e.g., California Univ., Berkeley, Engineering Research Inst. Note: California University is used rather than University of California, in order to increase retrieval accuracy and establish a uniform organization index.

(6) Title. TITLE OF THE ARTICLE IN ALL CAPITAL LETTERS, followed by a comma; e.g., REMOVAL OF ALGAL NUTRIENTS FROM RAW WASTEWATER: Lime,

(10) Personal Author(s). (Limited to five authors; transcribe surname, first name, and middle initial, e.g., Buzzell, John C, and Sawyer, Charles N.

(16) Project Designation. Project designation is usually shown on the report title page, e.g., OWRR Project A-007-ARK.

(21) Note. This entry is used for notes and statements deemed necessary as supplemental information, e.g., summaries in English and French.

(22) Citation. DO NOT ABBREVIATE. Enter here all necessary bibliographic information for identification of the source. Essential elements to be included are: title of journal or serial, volume, number, inclusive pages, date, number of figures, number of tables, and number of references; e.g., Naval Research Logistics Quarterly, Vol. 15, No. 1, p 63-29, March 1968. 8 fig, 2 tab, 8 ref.

For monographs the elements are: place of publication, publisher, date, and total pages, e.g., Baltimore, Johns Hopkins Press, 1968. 549 p.

(23) Descriptors. Use the Water Resources Thesaurus to select essential descriptors. Enter first those descriptors to be marked with an aserisk (or "star" symbol) as being the most important terms; followed by all other descriptors. Descriptors are separated by commas, e.g., *Aquatic ecosystem, *Energy budget, etc.

(25) Identifers. As necessary, select additional descriptive terms not found in the Water Resources Thesaurus. Place first those identifers marked by an asterisk as being the most important; followed directly by all other identifiers. Identifiers are separated by commas; e.g., *Largo Lake, Athens, Ga., Weiburg equation, etc.

(27) Abstract. The abstract should not exceed 200 words. Care should be taken to avoid typographical errors within the text of the abstract. At least one, and probably two, careful proofreadings should be made to eliminate errors. (note examples given in the Exhibits A thru E, and Appendix B to these instructions, as well as abstracts appearing in Selected Water Resources Abstracts.) Immediately following the text of the abstract the abstractor's last name and the name of his institution should be enclosed within parentheses, e.g., (Gysi-Cornell) for Marshall Gysi, Cornell University. The abstractor's full name, institutional affiliation, and location of institution must be provided in the blocks at the bottom of the form. Send the completed form to:

Water Resources Scientific Information Center
U.S. Department of the Interior
Washington, D. C. 20240

APPENDIX A

Informative Abstract

(Title): CANAL & CULVERT INLET-OUTLET TRANSITIONS

Model studies of variations in open-type inlet and outlet transitions for small canals and culverts were made to determine hydraulic losses. Closed conduit transitions between pipelines and open transitions resulted in lower losses and better performance. A closed conduit transition, 6 dia long, with circular inlet and rectangular outlet terminating in a headwall normal to the canal centerline performed best. Energy losses for this transition were 0.1 of the difference in velocity head in the pipe and canal (delta h sub v). Conclusions were: (1) Energy losses for conventional, broken-back, open channel transitions discharging from pipes into small canals are 0.6-0.7 delta h sub v. (2) Short, closed conduit expanding transitions between the pipeline and modified, broken-back transitions reduced outlet losses to 0.4 delta h sub v and less. (3) Reasonable changes in angle of divergence of sidewalls, invert slope of open transitions, or attitude of inlet pipeline had little effect on energy losses. (4) Outlet losses of existing broken-back transitions can be reduced by installing hoods within the structures to form controlled, closed conduit expanding sections. (5) Humps or flow spreaders on the inverts of open outlet transitions significantly reduced scour with slightly increased head losses.

Indicative Abstract (same document)

(Title): CANAL & CULVERT INLET-OUTLET TRANSITIONS

Hydraulic losses due to variations in open-type inlet and outlet transitions for canals and culverts are obtained from model studies. The effect of closed conduit transition sections between pipelines and open transitions is discussed and the best type is determined. Energy losses for transitions are reported in terms of the difference in the velocity head in the pipe and in the canal. The paper contains 5 conclusions on results of the model studies.

Informative-indicative Abstract

(Title): INCREASE YOUR PROBLEM-SOLVING ABILITY

One of the most gratifying things about creative problem solving is that once a person has developed a habit of inventively tackling problems, there is almost no limit to the ever-broadening area where he can use his creative ability. Intense motivation is the foundation of creative problem solving. Anyone who has experienced the satisfaction of solving problems creatively usually finds that satisfaction alone is sufficient motivation for further creative effort. Satisfaction in this sense is almost synonymous with self-confidence. The individual who has a broad knowledge of many fields and an abundance of accumulated experience can come up with new and significant creative ideas easier and more rapidly than the individual who has only a detailed specialized knowledge of one particular field. Guidelines are given for increasing the fund of total experience upon which to build new patterns and configurations when tackling problems. Many problems remain problems simply because they have not been properly defined. Steps are listed to increase understanding of a problem. The first step is to define the problem and a number of suggestions are made for analyzing, defining, and redefining. Various techniques are described which can increase powers of observation and association during creative problem solving.

Selected Bibliography

1. Hoegberg, Erick I. "The Abstractor and the Indexer," Journal of Chemical Documentation, 1962, Vol. 2, pp 165-167

General information on the purpose and function of abstractors and indexers.

2. Potter, G. J. C. "Abstracting," In Information and Communication Practice in Industry, Chap. 18, Singer, T. E. R. (editor) Reinhold Publishing Co. 1958, pp 281-292

Outlines the basic concepts of abstracting; thus it should be read by all abstractors.

3. Weil, B. H. Zarember, I., and Owen, H. "Technical-Abstracting Fundamentals. I..Introduction," Journal of Chemical Documentation, 1963, Vol. 3, pp 86-89.

Denotes the distinction between informative and indicative abstracts.

4. Weil, B. H., Zarember, I, and Owen, H. "Technical-Abstracting Fundamentals. II. Writing Principles and Practices," Journal of Chemical Documentation, 1963, Vol. 3, pp 125-132

How to write technical abstracts; the fundamentals needed for developing a concise writing style for abstracts.

5. Directions for Abstractors and Section Editors of Chemical Abstracts, 52 pages. American Chemical Society, Chemical Abstracts Service, Columbus, Ohio 1960.

These instructions, while specifically designed for chemical literature, are valuable aids for writing and editing abstracts.

6. Smith, Julian F. "Indexing," Information and Communication Practice in Industry, Chap. 17, Singer, T. E. R (editor), Reinhold Publishing Co., 1958, pp 270-280

Outlines basic concepts of indexing; thus it should be read by all indexers of documents.

APPENDIX G

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APPENDIX H

INITIAL LIST OF JOURNALS AND ABSTRACT SOURCES TO BE PURCHASED FOR AN OPERATIONAL CENTER

Journals

American Microscopical Society Transactions

American Midland Naturalist

American Water Works Association Journal

Analyst

Analytical Chimica Acta

Analytical Chemistry

Applied Microbiology

Archiv fur Hydrobiologie

Association of Official Analytical Chemists' Journal

Atomic Absorption Newsletter

Bulletin of Environmental Contamination and Toxicology

Canadian Fisheries Research Board Journal

Chemical and Engineering News

Chemical Engineering

Chemical Week

Environmental Science and Technology

Hydrobiologia

Industrial Water Engineering

International Journal of Air and Water Pollution

Internationale Revue des Gesamten Hydrobiologie

Journal of Phycology

Journal of Quality Technology

Limnology and Oceanography

Marine Biology

Measurements and Data

New Scientist

New Zealand Journal of Marine and Fresh Water Research

Nova Hedwigia

Pesticides Monitoring Journal

Phycologia

Pollution Engineering

Proceedings of the International Association of Theoretical and Applied Limnology (Verh. des Int. Verein Limnol.)

Science

Water and Sewage Works

Water and Wastes Engineering

Water Pollution Control Federation Journal

Water Research

Wildlife Review

World Health Organization, Chronicle

Abstract Sources

U. S. Government Research and Development Reports

APPENDIX I

Darby, R.L., Kohn, R.S., Carroll, T.E., Penniman, W. D., and Morrison, D. L., "Technical Intelligence and Project Information System for the Environmental Health Service. Volume II, EHS Information Network Analysis,", Battelle Memorial Institute, Columbus Laboratories, Columbus, Ohio, pp 80-84.

THE CONCEPT OF INFORMATION NETWORKS

Over the past 5 years, increased national recognition has been given to the concept of information networks. However, real progress in the establishment of operating networks has neither been particularly rapid nor clean cut. Before attempting to develop an information network for the EHS, it is desirable to examine the concept itself.

Perhaps the most flexible definition of an information network was developed by Becker and Olson(5) as follows:

> "In an information network, more than two participants are engaged in a common pattern of information exchange through communications for some functional purpose. . . "

In some instances, the functional purposes of information exchange may be quite general. For example, for years libraries have operated a very loosely constructed information network for the exchange of journals and books (interlibrary loans) and for the centralized storage of older and less used materials (archival storage).

However, in modern context, the functional purposes of information exchange are becoming more and more specialized. An example is the information system network

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*Requirements for that system, as an example, include:

System/360 with 64K of core storage and DOS
Console typewriter, card reader, and line printer (132 positions)
Five magnetic tape drives
Five 2311 disk drives
One 2321 data cell drive.

Source: "Operating Instructions for an Information Storage and Retrieval System", prepared for Consumer Protection Environmental Health Service by The Service Bureau Corporation, July, 1968.

being established by the Office of Education, the Educational Resources Information Center (ERIC). Even more highly specialized networks are being established or planned, one of which would be for the Environmental Health Service.

Two principal types of information networks appear to be evolving:

(a) Banding together of various types of information resources (e.g., libraries, information systems, referral centers) into some type of communications cooperative.

(b) A network of computerized information centers, presumably interconnected to permit machine-machine interfaces. It is generally assumed that man will interface with the computers through remote real-time access terminals.

Within these two broad categories, there may be multiple subsets designed to meet specialized requirements. For example, information networks may be identified as a combination of class of equipment, form of data, and function, examples of which are shown in Table 22. It is easy to visualize a form of information transfer network based upon almost any combination shown in the table.

The problem is one of choosing the best configuration or combination of configurations dependent upon the requirements to be placed upon the network, the benefits to be gained, and their cost effectiveness. The premature selection of both class of equipment and form of data can result in costly revisions and modifications at later dates. This has occurred all too often in the early design of information systems: the system was designed to fit the available hardware and later expensive modifications became necessary to meet user requirements.

The ideal characteristics for an information network, as presented in Becker and Olson's paper, provide a much more flexible basis for consideration of the networks. These are shown in Table 23.

The aspects of network organization warrant more detailed consideration. Figure 11 presents three basic alternative types of organization for information networks. The simplest of these is the monolith. The monolith is a highly centralized information system that draws together into one system those functions that might otherwise be performed by a number of individual systems. For its designated sphere of cognizance, the monolith acquires all of the required information, processes it into a unified store, receives and responds to all inquiries, and provides all the needed products and services for the entire user population.

The free, unorganized network permits individual systems to develop whenever and wherever they are needed. To the extent that interaction or cooperation between the diverse systems is required to properly service an inquiry or to provide other products or services, the operators of each of the individual systems must establish and maintain such channels of interaction as they see fit.

The concept of the coordinated network also permits individual systems to develop wherever needed. However, in this case, a central coordinating organization is superimposed on the population of individual systems such that the lines of interaction are markedly simplified as shown in Figure 11(c). For example, suppose an inquiry were

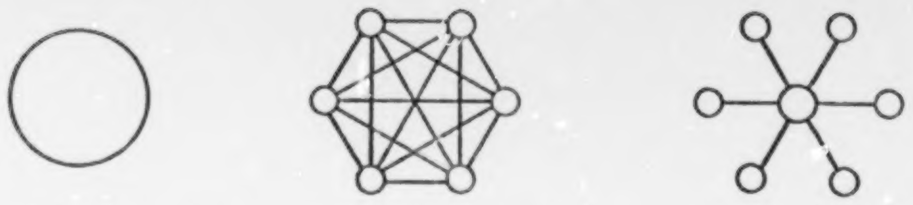
TABLE 22. IDENTIFICATION OF INFORMATION NETWORKS

Class of Equipment	Form of Data	Function
Telephone network	Digital network	Financial networks
Teletype network	Audio network	Library networks
Facsimile network	Video network	Biomedical information networks
Computer network	Film network	Educational networks
Etc.	Etc.	Agricultural networks
		Management networks
		Etc.

Source: Adapted from J. Becker and W. C. Olson, "Information Networks", Annu. Rev. Inform. Sci. Technol., 3, 289-327 (1968).

TABLE 23. GENERAL CHARACTERISTICS OF INFORMATION NETWORKS

Characteristics	Prescription
Formal organization	The combining of many sources through overall administrative control
Communications	Creation of circuits to connect geographically distant sources rapidly
Bidirectional operation	Provision for two-way flow of information between points in the network so that a user may also function as a source
Directory and switching capability	The capability to identify and access the best source(s) to satisfy a particular request

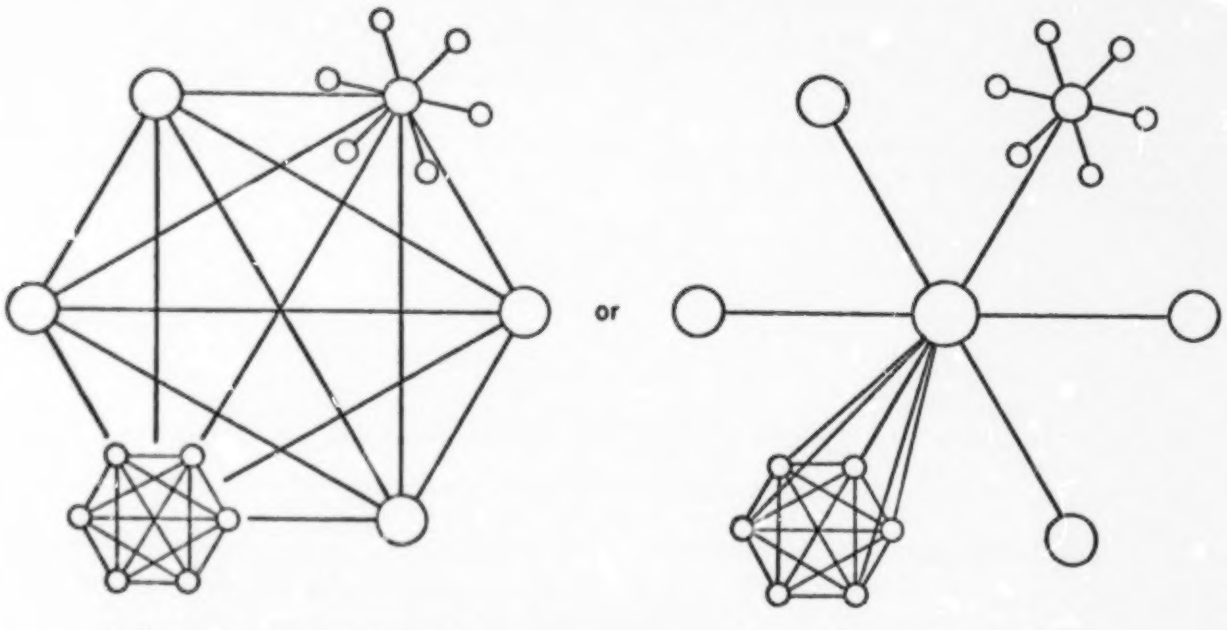


a. Monolith

b. Free-Unorganized Network

c. Coordinated Network

ALTERNATIVE



d. Free-Unorganized Network

e. Coordinated Network

AGGLOMERATED

FIGURE 11. NETWORK ORGANIZATIONS

directed to one of the systems in the network, but that a comprehensive response to the inquiry would require inputs from a number of the individual systems. In the coordinated network, the centralized coordinating body would assume the task of acquiring the coordinating multiple inputs and making them available to the one system that must answer the inquiry.

This characterization of the coordinating network provides the basis for understanding the concepts of the referral system and the switching system. In a referral network, the inquiry addressed to any individual system is referred to other additional systems that can contribute to the answer. This requires the inquirer to establish direct contact with those systems to which he is referred in order to obtain their inputs toward answering the inquiry. The switching network goes a step further in providing service to the inquirer. Having received an inquiry, the switching network establishes contact with all of the appropriate associated systems, acquires their inputs to the answer to the inquiry, consolidates these inputs and presents to the inquirer a comprehensive coordinated response to his inquiry. In the case of either the referral network or the switching network it is the centralized coordinating body that provides the intersystem cooperation required. These concepts are highly related to the basic information and data distribution patterns discussed in an article by Stanley Applebaum of Lever Data Processing Services, Inc. (36)

As an illustration, the series of three organizational models of Figure 11 might be applied to information-handling functions of a corporation. A corporation could consider building a monolithic information system, "the corporate information system". What is more likely to happen is that a corporation will allow each department (such as manufacturing, finance, accounting, personnel, sales) to devise and construct its own information-handling facilities as it sees fit. If this is the case, the corporate information system may become either a free unorganized network or a coordinated network (involving a centralized corporate information referral or switching group).

The same organizational models can be applied, for example, at the national level. The Soviet Union chose to implement the monolithic VINITI, the centralized Soviet national system for handling scientific and technical information. A brief look at the overall information-handling situation in the United States would show the "national system" to be a free unorganized network in which a proliferation of individual systems of various sizes, types, and subject areas have been permitted to grow and interact on an almost totally uncontrolled basis. The influence applied so far by the United States Government has been in the direction of achieving a coordinated national network of information systems rather than moving toward a monolithic structure.

The two examples above illustrates that the three organizational models can be applied to information situations at almost any level of generality or specificity. It is important to realize further that any single satellite system in either the free unorganized network model or the coordinated network model could itself be organized according to anyone of the three models (a monolith, a free unorganized network, or a coordinated network) as illustrated in Figure 11. Thus, these three organizational models can form a variety of combinations to represent the total complex of organizational relationships in all types of networks from the very simple to the very complex.

1 Accession Number

2 Subject Field & Group
10A

SELECTED WATER RESOURCES ABSTRACTS
INPUT TRANSACTION FORM

5 Organization
Battelle Memorial Institute, Columbus, Analytical Methodology Information Center

6 Title
DESIGN AND OPERATION OF AN INFORMATION CENTER ON ANALYTICAL METHODOLOGY,

10 Author(s)
Little, Robert L.
Darby, Ralph L.
Dennis, Bernard K.

16 Project Designation
Program #16020FS06/71

21 Note

22 Citation
June 1971, Final Report, Contract No. 14-12-862, 175 pp

23 Descriptors (Starred First)
Information retrieval, Data collections, Automation, Digital computers, Cost analysis, Chemical analysis, Analytical techniques, Aquatic microbiology, Instrumentation,

25 Identifiers (Starred First)
Information centers, Information storage and retrieval systems,

27 Abstract
Under WQO Contract Number 14-12-862, the Columbus Laboratories of Battelle Memorial Institute were commissioned to "design and operate a pilot analytical methodology information storage and retrieval system tailored to the needs of the Analytical Quality Control Laboratory (AQCL) and other segments of the National Analytical Methods Development Research Program (NAMDRP)".

The contractual requirements were met during a nine-month research period by the following activities: definition and statement of the AQCL scope of interests; acquisition of a total of 1145 technical reports and articles; abstracting and indexing of 470 technical documents; preparation of three prototype issues of a current awareness bulletin entitled "Reviews of Current Literature on Analytical Methodology"; preparation of 115 items for input to the Water Resources Scientific Information Center; provision of 13 quick responses to technical inquiries as well as other information services such as document loans and translations; consideration of methods for interacting with other facilities such as the Science Information Exchange (SIE); development of a procedure for processing and inputting information to a computerized information storage and retrieval system; demonstration of a computerized information storage and retrieval system at AQCL; Recommendations for an operational information center on analytical methodology; cost analysis of the recommended information center.

Complete discussions of all these activities are included in the report (Little--Battelle)

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